The Engineer.

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PUBLIC NOTICES.

Robert Gordon's Technical COLLEGE, ABERDEEN. (CENTRAL INSTITUTION.)

The Court of the University of Aberdeen and the Governors of Robert Gordon's Colleges co-operate in the PROVISION OF COURSES, leading to the Pass and Honours Degrees of B.Sc. (Engineering) of the University and to the Associateship of the Colleges in the Departments of—

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A COURSE of FIVE LECTURES, with lantern illustrations, on "THE MEASUREMENT OF LIGHT: ITS BASIS AND ITS SIGNIFICANCE," will be given by Mr. E. C. CRITTENDEN (Chief of the Electrical Division in the Bureau of Standards, Department of Commerce, Washington), at the INSTITUTION OF ELECTRICAL ENGINEERS (Victoria Embankment, W.C. 2), on OCTOBER 16th, 21st, 23rd, 26th, and 28th, at 5.30 p.m. At the first Lecture the chair will be taken by Mr. C. C. Paterson, O.B.E. (President of the Institution of Electrical Engineers).

ADMISSION FREE, WITHOUT TICKET.

S. J. WORSLEY, Academic Registrar.

7599

Huddersfield Education Committee.

HUDDERSFIELD TECHNICAL COLLEGE

Principal: J. F. HUDSON, M.A., B.Sc.

APPLICATIONS are INVITED for the APPOINTMENT of HEAD of the DEPARTMENT of CIVIL and MECHANICAL ENGINEERING, to commence duty in January next.

Salary £600-£25-£665, subject to any deductions made by Orders in Council.

Further particulars may be obtained on application to the undersigned.

L. G. THORNBER, Director of Education.

Education Offices, Peel-street, Huddersfield. 7615

APPOINTMENTS BOARD OF THE Imperial College of Science and TECHNOLOGY,

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The Civil Engineers Appointments BOARD, 8, Princes-street, Westminster, S.W. 1, acting under annual licence from the London County Council, invites INQUIRIES from EMPLOYERS SEEKING the SERVICES of PROFESSIONAL ENGINEERS, either as Assistants or in more responsible positions.

All those whose names are accepted for entry in the Board's Register for employment possess qualifications which have been attested by means of scientific examinations, practical training and experience. P1305

Metropolitan Water Board.

TENDERS FOR THE MANUFACTURE, DELIVERY AND ERECTION OF TWO STEAM TURBINES WITH CENTRIFUGAL PUMPS, ONE WATER-DRIVEN GENERATOR, AND ONE ELECTRICALLY DRIVEN BOOSTER PUMP AT KEMPTON PARK PUMPING STATION.

The Metropolitan Water Board invite TENDERS for the MANUFACTURE, DELIVERY and ERECTION of TWO STEAM TURBINES with CENTRIFUGAL PUMPS, ONE WATER-DRIVEN GENERATOR, and ONE ELECTRICALLY DRIVEN BOOSTER PUMP, at their Kempton Park Pumping Station, Hanworth-road, Sunbury Common, Middlesex.

Forms of Tender, conditions of contract, specification and drawing may be inspected without charge at the offices of the Board, Chief Engineer's Department (Room 173), on and after Monday, 12th October, 1931.

Contractors desirous of tendering may obtain the necessary documents from the Chief Engineer on production of an official receipt for the sum of Three Guineas, which must be deposited with the Accountant to the Board and which will be returned on receipt of a bona fide Tender, accompanied by all the above-named documents and drawing. Such payments and applications must be made between the hours of 10 a.m. and 4 p.m. (Saturdays, 10 a.m. and 12 noon). Cheques must be made payable to the Metropolitan Water Board and not to individuals.

Tenders, enclosed in sealed envelopes, addressed to the Clerk of the Board and endorsed "Tender for Turbines, &c., Kempton Park," must be delivered at the offices of the Board (Room 122) not later than 11 a.m. on Monday, 16th November, 1931.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER, Clerk of the Board.

Offices of the Board, 173, Rosebery-avenue, E.C. 1, 6th October, 1931. 7625

The Mental Hospital, Berrywood, NORTHAMPTON.

WORKING ENGINEER REQUIRED. Must be capable of carrying out general repairs in his department. Wages 60s. weekly, with cottage, subject to the provisions of the Asylum Officers' Superannuation Act.

Forms of application may be obtained from the MEDICAL SUPERINTENDENT, Berrywood, Northampton. 7637

The Engineer

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APPOINTMENT OF DREDGING ENGINEER.

APPLICATIONS are INVITED for the APPOINTMENT of DREDGING ENGINEER in the Board's service. The duties of the post will include the supervision of the operation and repair of the Board's Dredging Plant, having a present output of some 3,000,000 tons per annum. Candidates must be fully qualified mechanical engineers with extensive actual experience of large dredging plant (both bucket and suction types) in workshop, drawing-office and on dredging jobs. Ability to design is essential. Age 30 to 40 years. Period of contract three years. Salary £600 per annum inclusive.

Candidates should submit applications to the undersigned in sealed and registered covers, marked "Dredging Engineer," including, in addition to particulars as to the candidate's qualifications, photograph, certificate of health, certified copies of three testimonials as to actual experience in design, construction, operation and repair of dredging plant and as to personal character, list of names of three responsible referees, and a statement as to the earliest date the candidate could join the service. First-class travelling expenses by shortest route will be paid to the selected candidate. Letters from Europe should be marked "Via Siberia." Applications must be received in Shanghai before December 16th.

Shanghai, 16th September, 1931.

HERBERT CHATLEY, D.Sc. (Engrg.), M. Inst. C.E., Engineer-in-Chief.

7617

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It is devoted entirely to the science and practice of Metallurgy—ferrous and non-ferrous.

The following comments by a few of our readers indicate its usefulness in a field hitherto much neglected.

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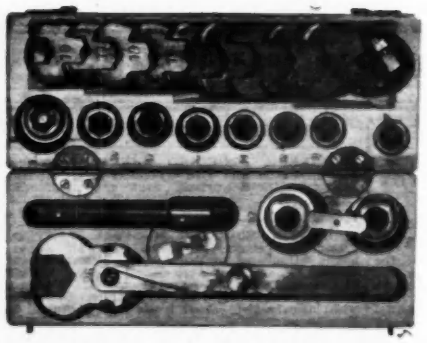

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A Seven-Day Journal

The Largest French Atlantic Liner.

When describing in our issue of July 17th the visit of the Institution of Naval Architects to the shipyard of La Société des Chantier et Ateliers de St. Nazaire Penhöet, we referred to the progress then made in the construction of the "Super-Ile-de-France" Atlantic liner for the French Line, which is to be electrically propelled and will have an approximate displacement of 70,000 tons. Further particulars of this interesting liner are now available. Her length is given as 310 m., or about 1017ft., with a beam of 35 m., or 115ft., and the designed output of her propelling equipment will be about 160,000 S.H.P., making the ship the largest turbo-electrically propelled, and, possibly, with the exception of the new Cunarder, the largest liner in the world. There are to be twelve decks, eight of which will be continuous, and accommodation is to be provided for over 2000 passengers, 800 of whom will be first-class. In her external appearance the ship will present new features, for her three funnels are likely to be of unequal height, the foremost being the tallest and the aft funnel the shortest. As recorded in the article already referred to, the construction of the hull is being proceeded with rapidly, and it is expected that the launch will take place during the autumn of next year, the new liner being ready for service about April, 1934.

A Colliery Merger.

In a Journal note on July 17th this year we mentioned that negotiations were proceeding for a merger of three collieries, William Baird and Co., Ltd., the Sanquhar and Kirkconnel Collieries, Ltd., which has been associated with the first-named firm for some time, and the Dalmellington Iron Company, Ltd. The directors of the last-mentioned firm now state that a provisional agreement has been reached with regard to the amalgamation of certain colliery interests belonging to the three companies. A new company, to be called Bairds and Dalmellington, Ltd., is to be formed to acquire the Ayrshire and Dumfriesshire collieries, railways, lands, and other properties, including the Muirkirk Ironworks, at present owned by William Baird and Co., Ltd. The collieries are to be taken over on a basis fixed by reference to the average trading profits earned in 1929 and 1930, while the acquirement of land, minerals, and ironworks will be at valuations to be mutually agreed upon. The authorised share capital of the new company will be £1,750,000, all in ordinary shares. William Baird and Co., Ltd., besides extensive interests in Ayrshire coal and iron, manufacture by-products of these minerals, and are interested in the production of cement, while the Dalmellington Iron Company, Ltd., is engaged in the production of bricks and has interests in coal.

The London Transport Bill.

Reference has already been made in these columns to the provisions of the London Passenger Transport Bill, which seeks to unify the passenger-carrying undertakings of the main line railways and the Underground and other groups in the London area. In the course of a speech in the House of Commons on Tuesday last, October 6th, Mr. MacDonald, in moving that the Bill be carried over to next session, said that the Government was under the impression that there was a real desire that the Bill should remain alive till next session. It was, he said, a large measure of constructive value, and was based on agreements between the railway companies, the Underground Company, public authorities and tramway companies. If the measure were now to be dropped, it mattered not what Government was in office, the problem of London traffic would again have to be dealt with. If, however, the Bill was carried over, as he suggested, it would be possible to take it up again next session at its present stage and carry it, he hoped, to a satisfactory conclusion. The motion was agreed to.

Canadian Ports.

With the arrival last Sunday of the grain carrier "Farnworth" at Victoria Dock, London, the first commercial cargo of wheat was successfully carried from the new Canadian port of Churchill on the Hudson Bay. An official welcome was accorded the vessel, which had brought 227,000 bushels of wheat. By shipping grain from the new port, the three Western Provinces are brought more than 800 miles nearer this country, and the Province of Manitoba about 200 miles nearer. Special aids to navigation had to be provided to make the sea route to the port safe for shipping, since both the Hudson Strait and Bay are troubled with ice, and fogs are frequent. Wireless directional-finding apparatus, icebreakers, and other equipment had to be provided. It is hoped that in the future cattle, lumber, and minerals from the northern territories of Canada will be exported through Churchill, and that coal and manufactured goods will be imported through the same place. The port will be open for about three months each year. In connection with Canadian ports, it is interesting to note that the Dominion Government recently requested Sir Alexander Gibb to examine the seaboard and express his views upon the future of the ports of the Dominion. He believes that Montreal is destined to be the great seaport of the country, even though the St. Lawrence deep waterway scheme, when carried out, will create 5000 miles of new seaboard, 2000 miles of which will be Canadian. He is not, however, in favour of the scheme for keeping St. Lawrence navigation open all the year round, and believes that in the winter months reliance must be placed upon Halifax and St. John. With regard to other harbours, he is of the opinion that the Government has wasted money in opening up 141 seaports on the eastern seaboard, but he believes the time will come when all Canada's large seaports will be self-supporting.

An International Coalmining Conference.

At the end of last week an international conference, lasting over two days, at which representatives of the coalowners of France, Germany, Belgium, Poland, Holland, Czechoslovakia, and Great Britain were present, was held in London under the chairmanship of Mr. Evan Williams, the President of the Mining Association of Great Britain. It was called to discuss the possibility of devising measures to meet the economic position of the coal industry in Europe, and was, we understand, very successful. A satisfactory consensus of opinion on fundamental principles was shown on Wednesday, the first day of the conference, and a committee was appointed to prepare a general statement of the results obtained by the discussions, which statement was, on Thursday, adopted by the full conference for submission to the colliery owners in the various countries represented. After the statement has been fully considered a further conference, it is understood, will be called. The general impression obtained from the recent conference seems to be that there is a friendly disposition on the part of all the coal-producing interests in Europe to act in co-operation with each other and with Great Britain, in order to bring about a working arrangement which will have the effect of eliminating severe competition and of stabilising the price of coal. It is well known that the outputs of all continental coal-producing countries have been greatly increased since the war. A productive capacity greatly in excess of the market demands, which has dislocated the export business of this and other countries, resulted. If a working agreement can be arranged between European coal producers, an important step in the rehabilitation of our national industry will have been taken.

The British Engineers' Association and Industry.

In a letter to the Prime Minister, putting forward the view that the immediate adoption of measures to check the abnormal flow of imports into this country; to ensure the earliest possible introduction of an effective protective tariff which would provide employment for British labour and increase the profitable employment of our factories; to restrict the importation of luxuries; to bring about Imperial preference; and to reduce the now devitalising burden of taxation on industry, are essential to the recovery and future expansion of our industries, the British Engineers' Association expressed the belief that measures of economy and taxation will not save the situation and that the financial rehabilitation of this country will depend mainly upon the rate at which new wealth is produced by its industries. Industries are the only means of providing that large proportion of productive employment which is the indispensable foundation of the economic structure of the nation. Industrial prosperity begets commercial prosperity, and the two combined beget shipping prosperity. When we speak of industrial prosperity we envisage a state of things characterised by the ability of the average well-equipped and efficiently managed works or factory to earn profits sufficient to yield a fair return on the capital. The Association entirely disagrees with the idea that our abandonment of the gold standard will so stimulate exports and restrict imports that a tariff is no longer of pressing importance. Experience has shown that these effects only continue so long as depreciation of the currency is in progress, and, furthermore, the temporary advantage may be neutralised by the depreciation of the currency of our competitors, which is, in fact, already taking place.

A Flight Across the Pacific.

Two American airmen, Pangborn and Herndon, landed at Wenatchee, Washington, last Monday, after completing the first non-stop flight across the Pacific Ocean from Japan. The journey took forty-one hours. The aeroplane took off at 7 a.m. on Sunday from Sabushiro Beach, in Japan, and passed over Seattle in America at 3 a.m. on Monday. The airmen hoped to be able to continue their flight to Salt Lake City, but, owing to fog, they had to turn back. Salt Lake City lies at a distance of 5200 miles from their starting point, so that, if they had reached it, they would have beaten the long-distance record of 4941 miles, set up by Boardman and Polando, two other American aviators, who flew from New York to Constantinople. As soon as the machine had left Sabushiro Beach, the landing gear was dropped, so that a "skid" landing had to be made when it arrived at Wenatchee. To minimise the risk from fire if the landing was bad, the remaining 100 gallons of petrol in the machine were dumped before it came down. Although the propeller was broken the landing was safely accomplished and neither of the airmen was hurt. Pangborn and Herndon set off from New York in July to fly round the world. In Japan they flew over Japanese territory without the permission of the authorities, and also took aerial photographs over forbidden zones. As a result they were each fined £205. However, by successfully accomplishing the first non-stop Pacific flight, they win a prize of £5000 offered by a Japanese newspaper.

An Andrew Laing Memorial Fund.

We are happy to be able to announce that the memory of the late Mr. Andrew Laing "as one of the great engineers of this century, and of his activities in the cause of the advancement of the sciences of engineering and shipbuilding," are to be perpetuated in the North-East district by an annual Memorial Lecture to be given under the auspices of the North-East Coast Institution of Engineers and Shipbuilders. The Lecture is made possible by Miss J. and Miss C. Laing, who, being desirous that a special fund should be founded to perpetuate the memory of their brother, have transferred to the Institution the sum of £2000. At an early date the Council of the Institution expects to be in a position to announce the first Andrew Laing Memorial Lecture. At the present time it may be stated that, in accordance with the terms of the trust deed, it will be on engineering or shipbuilding, and each Lecture will be given by the best intellect available.

University College, Southampton.

The Council of University College, Southampton, announces that it has appointed to the Chair of Engineering Wing Commander T. R. Cave-Brown-Cave, who, it will be recalled, had charge of the machinery installation of H.M. airship "R 101." Wing Commander Cave-Brown-Cave was born in 1885 and was educated at Dulwich College and the Royal Naval College at Greenwich. He entered the Royal Navy in 1901 and in 1914 was transferred to the Naval Wing, serving with the Royal Naval Air Service, and on its formation with the Royal Air Force. He had charge of the non-rigid airship design, construction and trials until 1918, after which he was engaged on airship research for the Admiralty and the Air Ministry. In 1924 he was appointed to take charge of the engines of the "R 101" at the Royal Airship Works at Cardington, and he made all the trial flights with the ship prior to her last voyage. He is a member of the Institution of Mechanical Engineers, also a fellow of the Royal Aeronautical Society, and has served on the Council of both these bodies; also an associate member of the Institution of Naval Architects. The first section of the new engineering laboratories at Southampton is now nearly ready for occupation, and it is hoped that the department will later undertake research work in connection with the development of the heavy oil engine. The Council has appointed as experimental engineer in charge of the laboratories Mr. H. Leech, A.M., who was foreman of the engine department at Cardington, and achieved distinction by his gallantry when the ship was lost near Beauvais.

Heavy Oil Fuel for Road Transport.

At a meeting of the Oil Industries Club, held in London on Tuesday last, Mr. E. B. Shrapnell-Smith gave some interesting figures with regard to the use of heavy oil fuel for road transport. After giving particulars of the use of omnibuses equipped with compression-ignition engines for burning heavy fuels in Belfast, Birmingham, and London, Mr. Smith went on to say that there were ten such vehicles now being run by the London General Omnibus Company. The record for 56-seater omnibuses was 48 ton-miles to the gallon for petrol, and 86½ ton-miles per gallon with the compression-ignition engine under comparable conditions. From the omnibus proprietors' point of view there were, however, drawbacks to the heavy oil engine, mainly on the score of weight, which would be at least 2 cwt. more than with a petrol engine for a double-deck omnibus, with another 200 lb. in addition should any preheating equipment be required. That difference would be equivalent to the loss of two or three seats on the omnibus. For private motoring the use of heavy oil was, he thought, very far off, though the time was now ripe for an extension of the use of heavy oil fuel for both omnibuses and lorries.

Press-Tool and Fixture Design.

By HENRY C. LANE.

No. VIII.—MISCELLANEOUS TOOLS (*continued*).*

Section II.—Hot Press Work.

In the previous section a finished spring was shown at B in Fig. 56. The flat blank for this spring is now shown at A in Fig. 58 and at B after the eye has been opened and embossed.

In the articles dealing with "Procession Tools," I mentioned that springs should normally be cut from the bar, so that the rolling grain of the metal lies longitudinally with the working path of the spring to be produced. Given perfect steel, I do not think that this would be necessary, but when it is remembered that bubbles of impurities are bound to occur in the cast ingot and that these bubbles will eventually be rolled out and form pipes along the bar of the metal, the resultant weakness of a spring working transverse to the grain of the metal is obvious. It will also be apparent that longitudinal stress will not be affected to any appreciable extent by the presence of such pipes. If the spring B in Fig. 58 is carefully inspected, it will be noticed that the

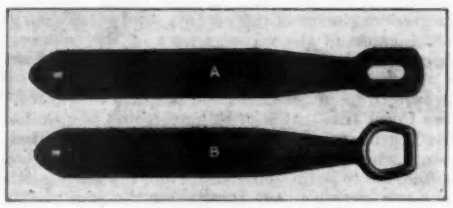


FIG. 58

overall width of the eye is greater than the width of the main bar of the spring, and it will be grasped that the shape of the eye immediately before embossing must exceed this width by a still greater margin. In one size of spring made on this principle, the main bar of the spring is only ¾in. wide, while the overall width of the eye prior to embossing is 1¼in. Three methods of production of these springs could be used. The springs could be cut from sheets and run together to eliminate most of the scrap, but this method would produce a spring action transverse to the grain of the metal. Alternatively, the springs could be blanked from the 1¼in. bar, but this would produce nearly 50 per cent. scrap; the sole remaining method and the one in use was to cut the springs from the ¾in. bar and stretch the eye to the required dimensions. The same principle of production is applied to all our springs made by unskilled workers, and the one illustrated is taken as an example mainly because the embossing tools for the eye are made on a new principle.

As in procession tools, so also with different processes, it is frequently advisable to work backwards through the stages from the finished piece back to

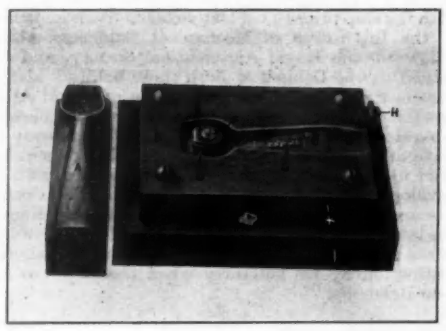


FIG. 59

the bar stock. This is practically essential in the production of these springs, to which there are three main stages—the blank, of bar width, as at A in Fig. 58; the blank with the eye stretched to a suitable shape for embossing, and the finished part embossed as at B in Fig. 58.

At one time the embossing tools for similar springs used to be cast to shape, but in order to give a sufficient strength to the thinner edges of the embossing punch, the section of the channel forming the eye could never approximate the desired true semi-circular section that could be obtained by the use of a tool steel punch which allowed of the thin embossing edges being reduced so as not to exceed the thickness of the stock on which they were working. Similarly, with a cast iron die, so long as the desired section was not forced a reasonable amount of wear could be obtained from such a tool, but as soon as the die was cast to produce the exact desired result, rapid wear took place in working, with a corresponding deterioration in the form of the pressings produced. A properly hardened steel die, on the other hand, stood up to the work reasonably well, but had the disadvantage

* No. VII. appeared October 2nd.

of high first cost and high repair cost. The original method of making a steel die was to start by shaping up a template of the finished piece cut from the solid and then through the laborious process of blueing, chipping and scraping until the template, fitting the die exactly, had sunk to the required depth in the die surface. This was one of the first jobs that I was put on when learning the practical side of tool-making, and the one die that I produced was quite sufficient to satisfy me for my natural life. Apart from the first roughing out, renovating an old sunk

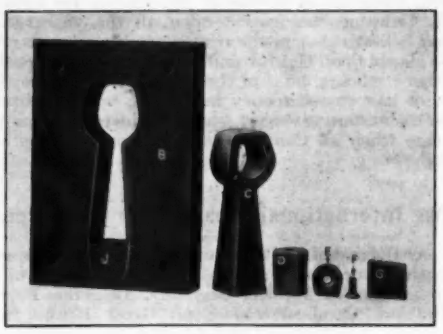


FIG. 60

die was very much the same cost as a new die, for, after the die had been annealed and the surface shaped or ground, the same sinking processes had to be followed to take the shape to the required depth and the die re-hardened.

The present method of producing embossing dies for these springs is shown clearly in Figs. 59 and 60. In Fig. 59 the complete tools are shown. The stretched eye of the blank is placed over the gauge plate E, and the edge of the blank pulled up to the side gauge H. The punch A shown alongside drives the blank

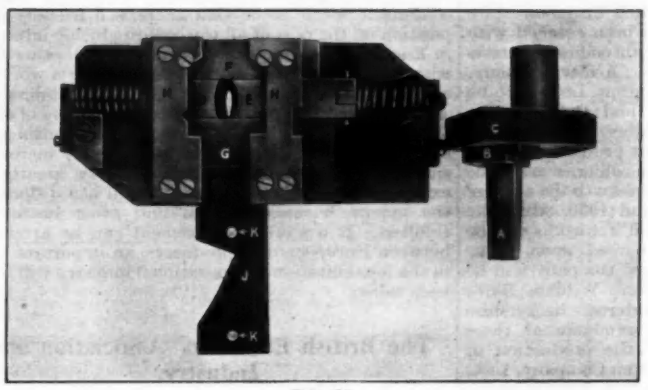


FIG. 61

into the die B and produces the required sections and contours. In other words, apart from the difference in channel section of the composite die block and that of a sunk die, the former being a square-sided channel of a width equal to the diameter of the semi-circular sunk channel and of a depth equal to the radius of the sunk channel, the two types of die are the same. In practice the semi-circular channel is absolutely unnecessary, as the slight draw effect causes the blank to take most of its shape from the punch.

In setting out to make a pair of tools for embossing we know the essential measurements are confined to the shape of the inside of the spring eye and the thickness of the material to be used. We accordingly lay out on a die block the exact finished shape of the eye, and from this shape we lay out a further shape, increasing the outline by three times the thickness of the stock to be used. This gives us the outer silhouette of the spring eye when finished. The outer lay-out is then continued to give a symmetrical appearance to the finished pressing, the two sides of the lay-out joined a short distance from the edge of the die block and a hole of this shape taken right through the block, as shown at B in Fig. 60. The next process is the making of the pad C to fit the hole in the main block exactly, and having its working or upper surface shaped to give any bends in finished shape that may be required. In the case in point, it will be noticed that one end of the pad reaches the surface of the main die block in Fig. 59, while reference to the finished piece B in Fig. 58 will show that there is a transverse cup bend to the main bar of the spring situated across the centre of the eye when embossed.

In the pad C a rectangular hole is provided for a marking punch, as shown at G, and a further hole, the exact shape of the inside of the finished eye, is provided to accommodate the centre die block D. The punch at A in Fig. 59 is then made by shaping a block to the bending contour of the pad C, clamping the two together and scribing the outline of the die and centre block on the punch from the pad. The thickness of the metal to be worked is then marked off from both these outlines, the punch shaped to size, and the various sharp edges rounded to present a comfortable radius to the various parts of the metal to be embossed. So much for the actual embossing tools. The required blank shape is arrived at by experiment, the amount of which is considerably reduced with experience. In each blank shape trial two blanks and one gauge plate, as at E, are required, and attention should mainly be paid to the shape and size of the eye in the flat blank, the outer shape being a later consideration. The gauge plate should be made to fit the blank eye only when the latter is heated, otherwise the expansion of the blank on heating will render the location by the gauge plate unreliable. All this experimental work takes time, but by careful application and consideration the number of trial sets of blanks should not exceed five, and in most cases the third set should give the correct shape for the blank and gauge plate, after which the gauge plate can be hardened and permanently included on the centre die block by means of the screw F.

In renovating the complete die the overall thickness is first accurately measured, and after removing the composite block from the die shoe and the gauge plate from the centre die block, the die is ground on its upper surface until the worn parts are eliminated. The new measurement of thickness is subtracted from the original, the centre die block completely removed, and the pad C carrying the name punch G tapped downwards through the main block to protrude from the underside by the amount of metal ground from the surface of the die. The underside of the pad and marking punch is then ground flush with the underside of the die, and subsequently removed therefrom to complete the renovation of the surface of the die, which requires stoning to a slight radius on the edges and slightly cupping at J to complete the embossing of the main bar of the spring.

Section III.—Hot Press Work (ii.).

The process immediately preceding the embossing of the spring is obviously the stretching of the eye, and this operation calls for a certain amount of ingenuity in design, as only two methods offer themselves for the process. One of these methods is only applicable to certain shapes, and comprises the insertion of two fingers or hooks in the eye hole of the blank, and pulling the fingers outwards to the required distance. This confines itself to shapes where there are two mainly straight sides to the finished hole, and, even so, accuracy in shape cannot be guaranteed, so that this suggestion is discarded in favour of a taper punch being driven into the hole, the full size of the punch being the shape required for the eye. If insufficient metal is left after piercing to fit satisfactorily the finished eye shape, the actual stretching of the metal around the taper punch guarantees a definite and accurate shape. These springs were originally made on this principle, using an expanding die for support of the metal and employing skilled labour, as the metal had to be repeatedly turned over and over before the taper punch could complete its stroke, as a strong tendency was developed for the metal to creep or draw down between punch and die rather than stretch in a horizontal plane. A special rapid stroke hand press was used for the job,

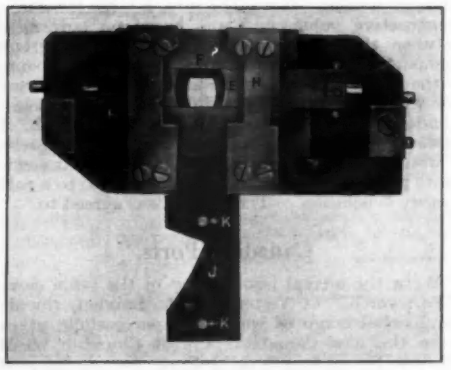


FIG. 62

a dozen blows and turns being easily possible at one heat, so that the spring eye stretching could be completed at the one heat. The job, however, called for muscle and a certain amount of skill, and to eliminate both requirements, I adapted the principle and built up the tools shown in Figs. 61, 62, and 63. The tools are designed for use in a power screw press, on account of the smooth and even speed of its stroke, and the final squeeze pressure obtainable. The press at my disposal was a double-sided frame, and would

not allow the die to be set square across the bed, so that I was forced to remove corners from the die shoe and offset the taper punch, as shown at A in Fig. 61. This taper punch is carried on to the main punch pad C, a square collar B slipped over it and screwed to the main pad being utilised to carry out a flattening process described later. To the die there are four principal parts, the three pressure plates D, E, and G, covering their three respective dies D′, E′, and G′, as shown in Fig. 63. D and E are hinged, as shown, and are kept apart by a small spring, while G is carried on spring pegs, as shown in the same

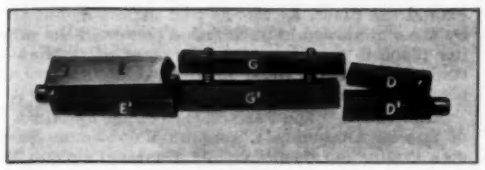


FIG. 63

illustration. The remaining principal part F is the same as G, in that it is composed of two main parts, but in this case the distance between the pad and die is maintained by a fixed distance piece. F is screwed to the die shoe under the straps H, G′ is screwed direct to the die shoe, and G floats on springs above it, and is retained in position by the pegs in the centre of the springs, and by the covering straps H. The complete dies D and E are held together by the main springs and slide under the cover straps H and between front and back dies G and F. Suitable L-shape skew gauges or U-shape channel gauges for the different widths of springs are clamped to the gauge carrier plate J at the holes K, a final or end stop for the blank being situated between the pad and die F. In operation, the pierced blank is heated and fed between G and G′, on between the two sliding pads and dies up to the final stop between pad and die at F. This brings the hole in the blank into register over the dividing line between the two sliding dies. The punch, on striking, tends to draw the metal through the dies rather than stretch the eye, but the metal is prevented from so doing by the various pads which in turn are prevented from rising by the straps H. A slight twist does occur, however, in the strip of metal forming the eye, and this is flattened out by the collar B of the punch coming into contact with the three pads D, E, and G. F, being solid, the collar pad on the punch is stepped away to miss this portion of the die when striking on the other three sides.

The actual making of the tools is rather a complicated process, as it is more or less impossible to draw it out satisfactorily and completely on paper. We start with the knowledge of the thickness of the material to be handled, and from the embossing tools we know the shape of the eye when hot; in other words, the full-size section of the taper punch must be identical with the shape of the plate gauge on the centre block of the embossing die. We therefore start by making a parallel-sided punch to this section, and follow up by making the two sliding dies D′ and E′ to fit each half of the section closely. From top to bottom of the punch stroke these dies must, where possible, fit the punch exactly if continual trouble is to be definitely eliminated. To do this the sides of the punch only should be tapered to an edge, and this is best managed by clamping each sliding die separately into position, so as just to conceal the ends of the centre line of the lower face of the punch, and the curve of the die edge can be scribed on the lower surface of the punch. After setting to the desired angle and shaping to this scribed line on each side of the punch, it can be finished accurately with a file using the two dies as curve gauges and, if necessary, using blue to indicate the high spots. The front and back dies should be just wide enough apart to allow of easy passage of the punch, and the sliding dies should be ground to move freely in this gap. As will be gathered, the two sliding dies cannot as yet contract any closer than the full finished width of the eye, on account of the points of each die adjoining the die G. These points can be ground away until the gap separating the two points that are furthest apart on the edges of the dies is not less than the maximum width of hole likely to be required in the plain pierced blank. At a later stage the points can be adjusted to reduce the gap to the measurement of the pierced hole, but until the hole width is determined some excess of metal should be left on these points. The pressure pads D and E also require careful handling. They must be made so that they will approach the edge of the taper punch as closely as possible without actually touching, the slides being always actuated by the taper punch striking the edges of the actual dies. The pressure pads should be hinged so that when they are parallel with the dies the gap separating die and pad is the exact thickness of the metal to be worked. The taper punch and all four dies and their respective pads must be "glass-hard" and highly polished.

Having produced the stretching tools, it is only necessary to arrive at the correct size and shape of piercing hole and outer edge of the plain blank. Cut from a bar of a definite width, the metal strip forming the eye must be increased in width, if necessary, by reducing the width of the piercing hole. Here, as in the case of the embossing tools, we are forced to experiment with pairs of trial piercings, but in this case I cannot limit the necessary number of trials to any definite figure. We have two parallel outer edges, a rounded end, and a shouldered shank, and all these parts alter their shape somewhat during the stretching process. A slight radius on the corners of the eye produced by rounding the perpendicular edges of the taper punch will cause a tremendous difference in the required plain blank shape, and for this reason it is essential that the wear on the taper punch must be negligible. The difficulty of definitely fixing on the shape of the piercing hole is to be gathered from the fact that for the various springs produced on this principle, though apparently the same in design, yet holes vary in outline from pear-shape to rounded end rectangular, and on to an almost perfect oval, while the cutting-off tools to produce the radius edge at the end of the blank vary from the perfect radius to practically a straight shear edge.

There may be some other way of arriving at the required blank shape, but so far I have not succeeded in tracing it, and have been forced to be content with the sometimes rather tiring routine of trial and error, as indicated above, which, though slow, is yet absolutely sure.

(To be continued.)

Iron and Steel Institute.

No. II.*

UNFORTUNATELY, owing to a very serious operation, Mr. G. C. Lloyd, Secretary of the Institute, was unable to attend the meeting, but Professor Henry Louis, Past-President, who occupied the chair on Wednesday morning, September 30th, was able to give the news that he was distinctly better. At the Chairman's suggestion, a letter was sent from the meeting to Mr. Lloyd, expressing sympathy and best wishes for his recovery. The duties of Secretary were carried out by Mr. A. E. Chattin, Assistant Secretary.

The first paper presented on Wednesday was on "Mottled Tin-plates," by Mr. J. C. Jones.

MOTTLED TIN-PLATES.

The author presented the following conclusions:—

The two chief factors upon which the formation of mottle depends are (1) the steel base and (2) the tinning pot conditions. It has been shown that different types of steel tinned under identical conditions vary in the degree to which they are prone to exhibit these markings. It has been demonstrated, further, that the substitution of some other salts for the zinc chloride commonly used as a flux results in striking improvements. It is suggested that the change is due mainly to alterations in the physical characteristics of the flux, and it seems likely that the important points about a flux are its viscosity and the presence of small gas bubbles.

Two methods exist by which tin-plates free from visible mottle can be manufactured. It has been shown that steels tested under identical conditions differ greatly in their behaviour in the tinning pot. The results of an examination of a selection of steels suggest that the reasons for these differences are connected with the depth and purity of the envelope of the bar. This aspect of the problem, however, has not been studied closely, and although it is recognised that a solution is possible in the direction of modifying the steel-making process to produce bars of the type of steel E, the present investigation deals mainly with the finishing process of the manufacture of tin-plates. Large-scale experiments with a number of fluxes have brought out the importance of this factor, and have shown that comparatively small modifications in the tinning operation can change the product from mottled plates to sheets free from this defect. The prospects of a solution of the mottle problem at the tinning stage of production are very promising, and there are reasons for believing that a completely workable way out of the difficulty can be reached.

Mr. A. W. Kieft, in a written communication, expressed astonishment at the opinion given by the author as to the cause of mottle on steel sheets lightly coated with tin, and was amazed at the qualities of steel used for his research, only one of which might be used for commercial tin-plate manufacture. The author's references to rimming steel† and continental steel were particularly dangerous, as most American and continental steels were of a rimmed nature. It was common knowledge that both American and European tin-plate works produced mottle from certain pots giving a low tin yield. Mr. Kieft said he had found, from years of experience, that the patterns described by the author and attributed as the base of mottle were present after detinning sheets, whether they were free from mottle or otherwise. The tin coating on sheets of 1·25 lb. per basis box were often free from mottle, whereas plates coated with 1·5 lb. were covered with mottle, and *vice versâ*. The same effect was produced on ordinary acid or Basic Welsh steels as with rimmed or continental steels. He was of opinion that the preparation of the steel sheet in the cold-rolling, annealing and pickling stages had a slight effect on the amount of mottle produced. The condition of the tin pot and rolls had a considerable effect on the type of tin-plate produced and its freedom or otherwise from mottle. The extent to which the mottle pattern was visible through the layer of superimposed tin depended essentially on the thickness of the tin coating.

Dr. P. M. Macnair said that while the author's experiments seemed to show that the steel base played some part in the production of mottle, he personally believed, from his experience, that it was a negligible part. The author had referred to an experiment which indicated that "when the tinning pot conditions were favourable" to the manufacture of mottled plates, even the purest iron obtainable in sufficient quantity for large-scale experiments developed the peculiar structure in some measure. Why use the term "when the tinning pot conditions were favourable"? Dr. Macnair suspected that it was only when the conditions of the tinning pot were unfavourable that mottle was produced, and that the steel base had nothing to do with it. He contended that the author had absolutely failed to prove that one of the two chief factors upon which the formation of mottle depended was the steel base. Dr. Macnair's own view of the formation of mottle was that the flux was definitely the cause. In his opinion the remedy against the production of mottled sheets was the use of a good clean flux and a long period of contact in order to ensure the complete absorption of the water. As to the opinion, which had been expressed in the trade, that foreign steel did not mottle to the same extent as did a home-made steel, Dr. Macnair confidently asserted that that opinion was due to inaccurate observation. Foreign steel had the great advantage that it was cheap, and that covered a multitude of sins; it even gave to the steel attributes to which it was not really entitled. Therefore he hoped that the pernicious habit of using foreign steel would stop, and that tin-plate manufacturers would do all they could to encourage home industries.

Mr. H. Spence Thomas (Melingriffith Works, near Cardiff), differed fundamentally from Dr. Macnair, and said he had found as the result of experience extending over a large number of years, that mottling was much more developed in open-hearth steel when rolled into tin-plate than in basic or acid Bessemer steel. The open-hearth steel producers had had their own way so much that they had come to the conclusion that no steel could be made except by the open-hearth process. That, of course, was fundamentally wrong, and perhaps later they would see the error of their ways. It had been said that the Bessemer process did give a cheaper steel, to the extent of about 8s. per ton, and if we were to compete and to live we must have cheap steel, by whichever process it was produced. At his works they were using Bessemer steel very largely—latterly the basic Bessemer steel—and there was a complete absence of mottling of that basic Bessemer steel. Whenever they had used open-hearth steel, made in Wales, with scrap and pig iron—not too much pig iron—they had found the mottling to be very pronounced, whereas in the same machine no mottling appeared when basic Bessemer steel was used. When they had used open-hearth steel made with a very large quantity of molten virgin pig iron, the mottling was very much less pronounced than when using the former open-hearth steel. At the same time, the mottling was still pronounced. Experiments were tried with puddled iron from the Midlands and mottling was present in that case also. He understood that when the surface of tin was removed from a mottled plate, the mottled effect was still present on the steel base, and he asked whether that mottled appearance continued right through the sheet to the other face.

Mr. G. H. Strick asked whether plates made by the old palm oil process, without flux, showed a tendency to mottle.

Mr. R. P. Bevan was concerned about the suggestion that tin-plates made from rimmed steel did not produce a mottled surface, and he suggested that the details of the paper did not bear out that contention.

Mr. Urias Williams, commenting on the remarks made about rimming steel and the effect of the segregate coming to the surface, said he would have expected some other difficulty to have arisen because of the penetration of the segregate through the thin envelope. He called attention to cases in which the mottle appeared in concentric rings on one side, and where there was a grey patch immediately behind on the other side of the plate, and he did not think the steel had very much to do with that. Examination of the steel by sulphur printing or by micro examination indicated no difference at all as between that area and the other areas of the sheet, and, indeed, it would need a very high flight of imagination to accept that steel would vary in patches in that way on one side, whilst on the opposite side there would be quite another phenomenon. With regard to the effect of flux, he said the author had had to carry out his experiments on a commercial scale, but had he been supplied with an experimental pot and a few observers and could have taken temperatures, analyses, and other data, perhaps he would have got a little nearer a solution of the problems. He had used a pot which was giving mottling at the time he had put the steels into it, and then, by substituting ammonium chloride for zinc chloride, he was able to remove the mottling. Mr. Williams asked what would have happened if the author had removed the spent zinc chloride and had put in the ordinary fresh flux. He also asked whether there was greater mottling on the thicker substance work than on the thinner substance.

* No. I. appeared October 2nd.

† Rimming is a term introduced, apparently from the United States, a few years ago. We have been unable to find a satisfactory definition of it, but, although vague, it seems to be understood by steelmakers. A clear definition is desirable.

Professor C. A. Edwards, F.R.S. (University College, Swansea), said that it had been suggested, and, he believed, unanimously agreed, that the flux itself, if not the primary cause, was substantially the cause of the trouble. With that he was in entire agreement. He put forward two suggestions for consideration to explain the cause of mottling. One was that mottle markings might be due to deposition of a substance, possibly tin sulphide, on the surface; the other was that a bubble might be formed on one side of a plate and by interfering with the transfer of heat through the plate, would be liable to give peculiar markings on the other side.

Mr. Gethin Jones suggested that the steels used by the author for his experiments were not comparable, and he expressed the view that the base plate had very little to do with the mottling. As to the suggestion to revert to the use of rimmed steel, he said that steel manufacturers had to exercise care as to the purposes for which they supplied rimmed steel, and it would be fatal to supply it for some purposes. He was afraid the author had made out a very poor case indeed, so far as the steel base was concerned.

Mr. E. Escott Wood, speaking as a steel maker, was interested to note that the tin-plate manufacturer was abandoning the view he had held for a long time, that the steel base was the cause of all his troubles. The paper proved almost conclusively that the trouble was not due to the steel base. The sulphur prints in the paper tended to show that practically every steel the author had used was segregated. Even if the base were the cause of any of the trouble, it was not the interior of the steel so much as the surface, and he asked if the author had pickled and examined the surface of the steel before rolling it into sheets.

Mr. C. Hopkins said that after much observation he had been led to the conclusion that the root of the trouble was the flux pot. He had prepared sheets in such a way that he could immerse them in the dry condition in the tin bath without putting them through any dehydrating agent, and in every case the mottle was entirely absent afterwards. He did not suggest that his method of treatment was practicable, but he had used it to test the effect of the flux box. His method was to immerse the sheet, after pickling, in a solution of copper sulphate, which would immediately give a slight copper film on both sides of the plate. The plate was then far more amenable to drying, without any fear of non-alloying compounds being formed on the surface. Subsequently, when the plate was immersed in the tin bath direct, there was a total removal of the copper, probably as the result of the alloying action of tin and copper, and the subsequent washing action of the tin bath, and the plate was invariably free from any sign of mottle.

Professor L. Taverner (University College, Swansea) suggested that the root of the trouble was in the positive and negative action on the sheet. As to the suggestion of Professor Edwards that it was to be found in the reaction probably taking place at the flux-tin interface, that was probably borne out by the fact that if a large amount of stannous chloride was added to the flux intentionally, the tendency to mottle was enormously increased.

Mr. Jones, replying, briefly intimated that he would extend his answers in writing.

The two papers next taken were one on "The Equilibrium of Certain Non-metallic Systems," by Professor Andrew, Mr. Maddocks, Mr. Fowler, and Mr. Howat, and one on "The Chromium-Iron Constitutional Diagram," by Mr. F. Adcock. They were only briefly discussed, and we do not propose to deal with them.

A paper on "The Effect of Surface Conditions Produced by Heat Treatment on the Fatigue Resistance of Spring Steels," by Dr. Hankins and Dr. Becker, was then presented. The authors give the following summary of its contents:—

SURFACE CONDITIONS AND SPRING STEEL.

Introductory: Purpose of Investigation.—Previous investigations have shown that the fatigue resistance of unpolished spring steel is much lower than that of completely polished specimens of the same materials, the difference being due to the presence of defects at or near the surface of the metal. The present investigation has been carried out with the object of studying the effects of two forms of surface defects which may arise in heat treatment, namely, small surface cracks and surface decarburisation; and, if possible, the development of methods of heat treatment whereby such defects may be minimised or eliminated.

Range of Investigation.—The possible effect of small surface cracks was first considered, and although indications were obtained that extremely small surface markings, possibly of the nature of cracks, may occur at the surface of a quenched and tempered spring steel specimen, such defects did not appear to be a major cause of the low fatigue resistance. The effect of surface decarburisation was studied and found to be very marked. Various heat treatments and subsequent fatigue tests were carried out with a view to the development of a practical treatment which did not produce decarburisation. These included treatments *in vacuo*, with furnace gases under control, and in various salt bath mixtures.

Conclusions.—At present the results apply to material in which the defective surface layer arising in manufacture is first eliminated by machining. It is shown that when surface decarburisation during heat treatment is prevented practically the full fatigue resistance of the steel is obtained without further machining or polishing subsequent to heat treatment. Details of treatments which enable this to be done are given.

Further Developments.—It is proposed to attempt the development on similar lines of heat treatments which increase the carbon content in the decarburised surface layer that is produced during the rolling stage of manufacture of spring steel plates.

The investigation described in this paper was carried out at the National Physical Laboratory. The experiments were commenced with the approval of the Springs Research Committee of the Department of Scientific and Industrial Research, but the major portion of the investigation was carried out as part of the work on the effect of surface conditions on the fatigue resistance of steels, supervised by the Executive Committee of the Laboratory.

The very high practical value of the paper was commented upon by Professor Henry Louis (Past-president).

Mr. E. H. Saniter (Vice-president) also welcomed the paper for the same reason, and said that there was a great dearth of papers of that description, giving the results of investigations carried out with a view to their application to practice, though, of course, papers dealing with fundamental microscopical and micrographical work were none the less welcome. The prevention of surface decarburisation, he continued, was apparently a great feature in the improvement of spring steel. Surface decarburisation was found in an ingot as it was cast, and was very often increased in the various rolling processes, and he suggested that in the bulk of steel made the amount of surface decarburisation which occurred during heat treatment was very much less than that which occurred prior to the heat treatment. A bar consisting partly of 0·1 per cent. carbon steel and partly of 0·6 per cent. carbon steel would be considerably weaker as a member than would a bar consisting of 0·6 per cent. carbon steel throughout. He was not in a position, such as the authors were, to say how far that was due to decarburisation, but he did not think it was entirely due to it; probably the lower fatigue limit of the 0·1 per cent. carbon steel was an important factor. But it was important to bear in mind that a decarburised bar of the same section as one which had no decarburisation must naturally be the weaker, and therefore the stress to which it was subjected in practice must be very severe. The various treatments, including turning and polishing, which brought about such different results from those of the ordinary commercial methods, had not yet been developed, in his opinion, to a point at which one could judge them with great certainty. Finally, he wondered whether it was possible, by further practical trials of springs, to make sure that the fatigue resistance test used by the authors was comparable with their treatment in commercial use.

Mr. R. S. Brown, who was interested in springs for automobile and aero-engines, said that any work conducted with a view to solving the problem of patenting a rod at high temperature in such a way as to avoid decarburisation would be of very great service.

Owing to shortness of time available, the authors intimated that they would reply to the discussion in writing.

A paper on "The Solidification and Crystallisation of Steel Ingots," by Dr. Matuschka, was then read, and very briefly discussed. It was followed by a paper entitled "Production Economy in Iron and Steel Works," by Dr. Cromberg, which was presented, in the absence of the author, by Mr. E. C. Evans (National Federation of Iron and Steel Manufacturers), who reminded the meeting that it followed an earlier one by Dr. Cromberg presented last May. In the earlier paper he had given an outline of time studies for tabulation, but in this second paper he had carried the matter a stage further to the use of those time studies for costing. The basis of that costing system was the expression of production, not in terms of tons per minute, but of minutes per ton. The second paper, he said, provided a new method of examination of works production, which could be simplified very considerably for British practice, and which he believed would be, in its ultimate applications, of considerable advantage to the industry.

Mr. James Henderson (Vice-president) said that the constituent works of the United Steel Companies, with which he was associated, had been working out, under the guidance of the head office, systems of costing for checking efficiency of operations and profit and loss, and had developed on lines which apparently were indicated in Dr. Cromberg's paper. Before the end of any one week they received the costs for the previous week, for both the purposes mentioned. Very great benefit indeed was derived from those costs, because they enabled the managements to check up the previous week's operations, and, before the circumstances had faded from the minds of managers, foremen, and workmen, to track and correct troubles that had arisen. Commenting on Dr. Cromberg's suggestion that foremen and departmental managers should be rewarded by bonus, according to how the costs of production worked out, Mr. Henderson said he could not quite see how such an arrangement could be applied with safety, one reason being that so many of the factors contributing to the costs were outside the control of foremen or even departmental managers.

Mr. D. J. Young, an accountant, commented upon Dr. Cromberg's suggestion that when estimating the efficiency of works management it was desirable to eliminate external influences, and to that end to use standard fixed prices for raw materials and other goods bought outside. Mr. Young said that that would be an unfortunate departure in the heavy steel trade in these days of constantly changing prices, and one might be following a wrong path for quite a long time. In connection with material costs, Mr. Young emphasised the importance of the crediting of scrap.

Sir William Larke (Director, National Federation of Iron and Steel Manufacturers) recalled that time studies were invented in this country twenty-five or thirty years ago. They were a natural development of the early application of electric power to production processes, because electric power gave a very ready means of undertaking time studies. The value of the paper was not so much in the detailed system which the author advocated as in indicating the usefulness of time studies as a tool in governing costs. He agreed entirely with Mr. Young's view as to the adoption of fixed prices for materials. Emphasising the value of time studies in connection with the planning of works operations and their sequence, he said that in many cases where it had been necessary to increase the production of a works, careful analyses on the basis of time studies had shown that it was not necessary to extend the plant, as was at first expected, but that by the elimination of unbalanced factors in the existing plant a very important increase of production could be effected. Those unbalanced factors were not always obvious to the management.

A paper on "The Surface Hardening by Nitrogen of Special Aluminium-Chromium-Molybdenum Steels on a Production Basis," by Mr. Cunningham and Mr. Ashbury, was then taken. In this paper the authors explain the process of nitriding as carried out productively by Thos. Firth and John Brown, Ltd.

Mr. B. Jones, who has carried out a lot of work on nitriding experimentally, said it was remarkable that a plain carbon steel would not harden by nitriding, but when 1 per cent. of aluminium was added in solid solution it would attain extraordinary hardening properties. The process would compare favourably with case hardening, because the nitrided steels retained their hardness up to a temperature of 500 deg. Cent., whereas that temperature would have a marked softening effect on steels treated by the ordinary process. He asked for information as to the cost of nitriding per pound of steel treated, and the consumption of anhydrous ammonia. The authors had stated that the best results were obtained when working with a gas dissociation between 25 and 30 per cent. This meant, said Mr. Jones, that the most efficient gaseous nitriding mixture was 70 per cent. undissociated ammonia plus 30 per cent. of a mixture of atmoic hydrogen and atomic nitrogen, and it was assumed that the atoms of nitrogen caused the marked hardening. It was a practical fact that if more than 30 per cent. dissociation were caused, either by raising the temperature of the furnace or varying the rate of flow of gas through it, one did not get a greater hardening effect—as one would expect, because there was more atomic or active nitrogen in the system—but a marked softening effect, as described by the authors. Some years ago, when experimenting with the process, the hardness figures were rather low when dealing with the class of steel treated by the authors, but as the result of using a sensitive pipette for measuring the rate of dissociation of the gas and limiting the dissociation to 30 per cent. he had brought about a very remarkable hardness in the marginal layers of the steel.

Mr. Cunningham, in reply, said that there were many theories concerning the mechanism of the nitriding process, the most popular, he believed, being that the results obtained were due to the compound Fe_3N, made by the action of the ammonia gas and nitrogen on the steel. As to the cost of nitriding, it compared very favourably with that of case hardening, but it would depend almost exclusively on the weight of the article to be nitrided. The smallest article his firm had treated weighed 0·0018 oz., and the largest weighed 18 cwt., and, of course, there must be a scale of charges, the larger articles being treated at a lower rate per unit—of size or weight, for example—than the smaller ones. The time occupied by the nitriding process was one of the great drawbacks. Experiments were being made in America with a view to shortening the period, by high-temperature treatment followed by low-temperature treatment, or *vice versâ*. Judging by reports he had seen, that method gave a hardness figure of about 900 (Vickers Brinell) and the Americans seemed satisfied with that, whereas in England a hardness figure of 1100 or 1200 was required. There were many drawbacks to high-temperature nitriding—liability to sagging in the box, surface cracks, enormous increase in dissociation and of the amount of ammonia used, and the tendency towards decarburisation. Therefore his firm preferred the old tried method, involving eighty hours' treatment at 500 deg. Cent., and was getting very good results.

In the absence of Mr. N. T. Belaiew, the author, the paper on "The Structure of Nodular Troostite" was taken as read and was not discussed. The final paper of the session was one by Professor Thompson and Mr. R. Willows on "A Critical Study of the Origin of the Banded Structure of a Hot-worked Hypo-Eutectoid Steel."

The doubling in power of Heilsberg, the 75 kW broadcasting station near Königsberg, is contemplated in the near future. It is also reported that negotiations are in progress for a new site for a super-power station at Hamburg. At Ochsenzoll, near Hamburg, a temporary transmitter is being used for field strength measurements. Next year a new Bavarian station will be erected near Munich with a power exceeding 75 kW. The high-power stations at Frankfort, Leipzig and Breslau will probably begin their first tests in February or March next.

The Shipping, Engineering and Machinery Exhibition at Olympia.

No. V. (*conclusion*).*

SULZER BROS.

IN addition to the gear wheel measuring devices mentioned in our issue of September 11th, Sulzer Bros., of London, showed two Maag machines, one a gear generator and the other a gear grinder. The gear generator was closely similar to the Maag machines of this class which we have described on previous occasions. The gear grinder, Fig. 113, while it followed the familiar Maag principle, was new in so far that it was adapted to grind helical gear wheels also present in the helical gear grinder illustrated in Fig. 113. In addition to them the helical grinder is provided with a swivelling motion to the grinding wheel head whereby the grinding wheels may be set over so as to lie relatively to the axis of the work at an angle equal to the helical angle of the gear wheel being ground. Further, an additional motion has to be provided for the work. As it is reciprocated and rolled relatively to the grinding wheels, it has also to be turned on its axis through an amount corresponding with the lead of the helical teeth. This motion is obtained by mounting the pitch block on a slide which is coupled through a sliding block to a guide set to the helix angle of the gear wheel.

The machine is driven at a rate which may be varied from 100 to 200 generating strokes per minute.

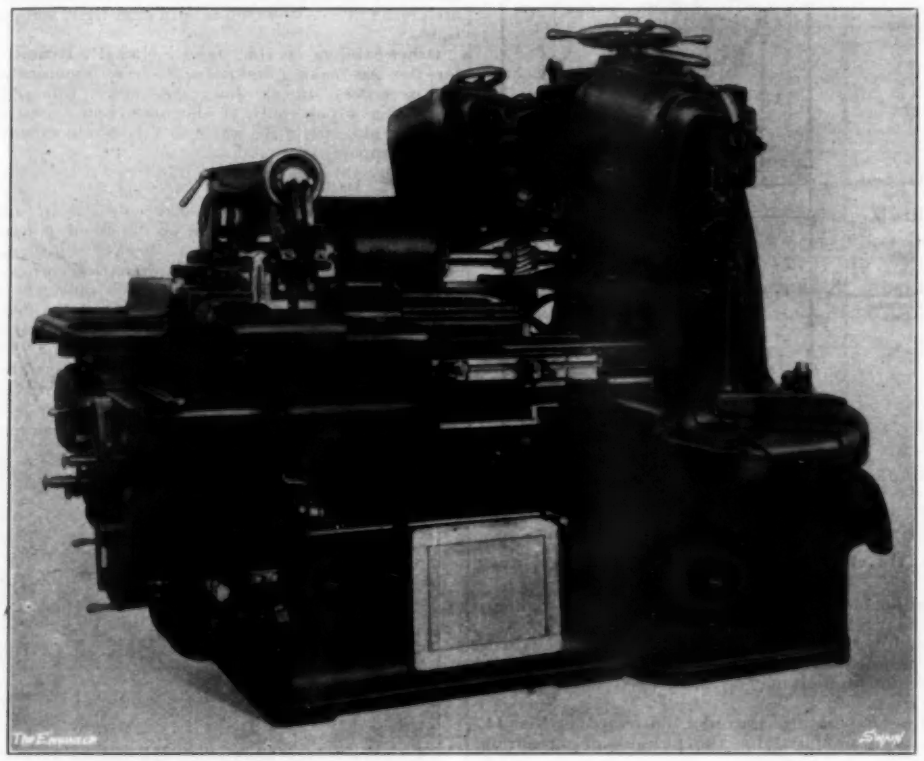


FIG. 113—MAAG GRINDER FOR HELICAL GEAR WHEELS—SULZER

and was not confined, as were the earlier patterns, to the grinding of straight spur wheels. The Maag gear grinding principle is now quite familiar. It is distinguished from other systems making use of a formed grinding wheel by the fact that the involute profiles of the teeth are ground by a generating process. Two saucer-shaped wheels are employed. They are mounted back to back at the ends of two shafts, each of which is inclined to the horizontal at the pressure angle of the teeth being ground. Although the cut is taken only by the rims of the saucers, the rotation of the grinding wheels, combined with the reciprocation of the work past them, results in the grinding edge being extended in effect into a grinding plane. These two grinding planes are inclined to one another at an angle and are set apart at a distance such that they coincide with the flanks of the straight-sided or involute rack with which the gear wheel being ground is capable of meshing. In other words, the grinding planes replace the cutting edges of the rack cutter by means of which the teeth of the work have been shaped. The grinding planes are kept in position by means of diamond-pointed feelers, which every three or four seconds come automatically into action to determine the amount of wear which has occurred. Any wear discovered is automatically corrected by means of an electrical contact system, which secures the result that the wheels are moved parallel with their axes of rotation by the amount of wear which has taken place at their rims. It is claimed that by these means the grinding plane can be maintained in its correct position to within one ten-thousandth of an inch.

The involute profile is given to the teeth by reciprocating the work relatively to the grinding wheels in a direction parallel with the axis of the mandrel on which the work is mounted and at the same time by rolling the work relatively to the grinding wheels. This rolling motion has to reproduce that which the work would receive if it were moved along the imaginary rack of which the two grinding planes constitute a tooth. The rolling motion consisting of a combined rotation and translation is controlled by a cylindrical cam or pitch block at the end of the work spindle and by steel ribbons anchored to the frame of the machine and wrapping and unwrapping themselves round the pitch block.

The details described above are to be found in the original Maag spur gear grinding machine. They are It can be set to take one or two roughing cuts and then to change automatically to a finishing rate of feed and to stop when the work is completed.

* No. IV. appeared October 2nd.

THE SPERRY GYROSCOPE COMPANY, LTD.

Of the exhibits shown by the Sperry Gyroscope Company, Ltd., of London, that which chiefly attracted attention by reason of its novelty was the artificial horizon instrument for use on aeroplanes. At night, in fog, or in clouds, the pilot of an aeroplane, unable to see the horizon, has, in the absence of an instrument, to rely on his sense impressions to tell him when he is flying level, longitudinally, and athwartwise. The "feel" of his own weight and the indications which he receives from the mechanism of the inner car are, however, untrustworthy guides in this connection. Any acceleration of the machine, linear or radial, combines with the acceleration of gravity. The pilot's sense impressions are affected by the resultant, and he is unable to distinguish the true gravitational vertical. The Sperry artificial horizon is a gyroscopic instrument designed to indicate the lie of the horizon on a dial on the instrument board in the cockpit.

The device makes use of a fly-wheel with vanes round its rim, and mounted inside a casing—Fig. 114. Into the casing air is drawn by means of a venturi tube fixed in way of the slip stream from the air screw. The air, after impinging on the fly-wheel blades, escapes from the casing by way of four ports B spaced at 90 deg. apart in the lower portion of the casing. With each port there co-operates a swinging vane A. When the gyroscope axle is vertical air issues equally from all four ports. If, however, the casing tilts about its longitudinal or athwartwise gimbal axis the movement of the casing relatively to the longitudinal or athwartwise pair of vanes will result in one of the vanes—that nearest the reader as the instrument is represented in Fig. 114—increasing the exit area through the corresponding port B, while the vane on the other side of the casing will decrease the corresponding exit area. The two vanes at 90 deg. will neither increase nor decrease their port areas. The increased volume of air issuing from the port B and the decreased volume issuing from the opposite port combine to upset the previously prevailing equality in the reaction of the jets. As a result, a turning moment is applied to the casing and fly-wheel about the axis at right angles to the axis about which they have tilted. In accordance with familiar gyroscopic principles, this moment produces precession about the axis of tilt and the direction of this precession—the direction C in the case illustrated—is such as to cause the fly-wheel and casing to recover from the tilt.

It will be seen therefore that any displacement which the fly-wheel and casing may acquire, whether from the existence of frictional or accelerational moments, will be at once counteracted by a reverse precession induced by the dislocation in the equality of the air jet reactions. The gyroscope axle is therefore preserved vertical during all manœuvres of the aeroplane, and cannot acquire a permanent departure from the vertical. It may perhaps be objected that the vanes, being pendulous, must respond to any acceleration, linear or radial, experienced by the

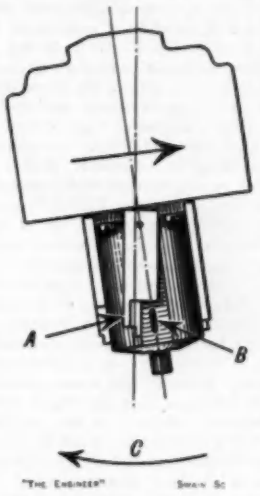


FIG. 114—HORIZON GYROSCOPE—SPERRY

machine, and therefore that the casing when it sets itself in line with them aligns itself in a direction determined by the resultant of the acceleration of the machine and the acceleration of gravity. According to a recent report issued by the Aeronautical Research Committee, the acceleration of an aeroplane in the hands even of a skilled pilot may in some manœuvres easily reach a value as high as 3 *g*. It would therefore appear possible that in certain circumstances the pendulous vanes may, under the influence of acceleration, take up a position inclined at 70 deg. or more to the true vertical. The gyroscope setting itself in line with the vanes would then give a false indication of a dive or a bank, when in reality the machine was only accelerating horizontally or executing a flat turn. This argument is theoretically sound, but in practice the instrument is intended for

FIG. 115—INSTRUMENT PANEL—SPERRY

use in transport machines rather than for machines required to execute aerobatics. The accelerations encountered are therefore normally low, and last only a short time in most cases. Further, the gyroscope follows the vanes with a certain amount of time lag. Hence in normal circumstances any acceleration which the machine may experience has little effect on the gyroscope, and as soon as the period of acceleration is over the vanes fall back to the true vertical. Any slight displacement which the gyroscope may have acquired during the period of acceleration is at once counteracted by the reverse precession which sets in when the vanes return to the vertical. The worst conditions which can be encountered in this respect are those occurring when the machine executes a long slow turn. The centrifugal force acting on the vanes will lead to the gyroscope precessing slowly into a position indicating a bank. The error will, however, be eliminated on the resumption of straight

flight, and at the worst, the makers inform us, is slight.

The horizon indicator is shown in Fig. 115, combined on a panel with a direction indicator and a turn and bank indicator. The horizon instrument dial carries the representation of an aeroplane, as seen looking forward from the tail end. Behind the silhouette is a background shading from blue at the top to represent the sky to black at the foot to represent the land. Between the silhouette and the background is a bar connected with and controlled by the gyroscope. A banking movement of the machine appears to cause this horizon bar to tilt relatively to the wings of the silhouette, while during a dive or a climb the bar appears to rise above or fall below the level of the wings. The bar, the silhouette and two arrow heads on the edge of the dial are treated with radium paint. The instrument is capable of indicating banks up to 90 deg. and dives or climbs up to 60 deg.

The direction indicator is another gyroscopic instrument. Gyroscopic compasses for aeroplanes have not been found to be particularly satisfactory, chiefly because of their weight. The ordinary magnetic compass is also not completely satisfactory, except when the machine is in steady flight. When the machine turns or encounters disturbances in the air, the compass card is usually found to acquire a considerable amount of oscillation. It is therefore frequently difficult to hold an aeroplane very closely on a given course by means of a magnetic compass, and, in addition, it is, in general, impossible with that instrument alone to execute with certainty and accuracy a turn of a specified amount off a given course. The Sperry direction indicator may be described in a crude way as a gyroscopic compass which does not possess the usual meridian-seeking property. It consists of a fly-wheel driven by air, as in the manner adopted in the artificial horizon instrument, but with the axle of the fly-wheel arranged horizontally within gimbal rings. Encircling the gyroscope is a vertical compass card. Below the window there is a knob which when pushed inwards engages the gyroscope and card, and which when turned enables the pilot to turn the gyroscope and card to any desired setting. When the setting knob is released, the gyroscope will remain with its axle aligned in the position in which it was set.

In use, the aeroplane is flown steadily until the magnetic compass ceases to oscillate. The directional gyroscope is then turned until it is set at the course which it is desired to follow. Thereafter for a certain space of time the instrument will serve as a compass, which will not be subject to oscillations consequent upon turns or air disturbances. In the course of time the effect of friction at the gimbal pivots or accelerations of the aeroplane may cause the directional gyroscope to drift off its original setting. At from 15 to 30-minute intervals, it is checked against the magnetic compass and any drift which may have occurred is corrected. The makers state that the instrument can be depended upon to maintain any setting to within three degrees of arc over an interval of 15 minutes.

The turn and bank indicator shown in Fig. 115, mounted on the panel carrying the Sperry horizon and direction indicators, is a third air-driven gyroscopic instrument, made by the Pioneer Instrument Company of New York. It would appear to combine in a single instrument certain of the functions fulfilled by the other two devices.

G. Kent, Ltd.

The principal exhibit on the stand of George Kent, Ltd., Biscot-road Works, Luton, was a panel of boiler and turbine instruments, comprising the following meters and recorders:—A steam flow recorder, a water flow recorder, a combustion efficiency meter, a temperature recorder, a pressure indicator, and a multi-point draught gauge. All these instruments are uniform in appearance and are mounted flush with the panel. There were also various forms of Venturi meters, including one specially designed to deal with the pulsating flow of hot water common in boiler feed work.

The balanced recorder which we illustrate in the drawing, Fig. 116, has been designed to work in conjunction with orifices, nozzles, or Pitot tubes, and to give an equally spaced flow scale down to one-tenth of the maximum flow.

The instrument comprises an annular chamber, which appears as a large circle in the upper part of Fig. 116. This annulus is mounted on knife-edges at its centre and is divided by a diaphragm at the top, so that it virtually forms a U tube with closed ends. It is partly filled with liquid, and the upper ends of the legs of the U are connected with the differential pressure tubes. These connections can be seen in the drawing as a pair of metal tubes ending in unions at the centre of the annulus and continued by flexible pipes to the branch cocks. It will be readily appreciated that a difference in pressure in the two pipes will result in the displacement of the liquid in the annulus and consequently a tendency for it to turn on the knife-edges. This tendency is resisted by a cam weight which is suspended over a thin steel band from a specially formed cam that rotates with the annulus. A band also actuates the indicating pointer, and the shape of the cam is such that the divisions of the scale are open and equal. As a consequence a bold pointer can be used, which can be read at a distance. In order to permit the instrument being used over a wide range of flows several different cam weights are provided and can be easily hooked in place—a much more simple arrangement than the alternative of changing the orifice.

The low-pressure instrument can be supplied to work at various maximum heads between ½in. and 4in. This instrument is suitable for working up to pressures of 20 lb. per square inch. The chart is of the continuous roll type, and is provided with three speeds for controlling the rate of feed. The chart is driven

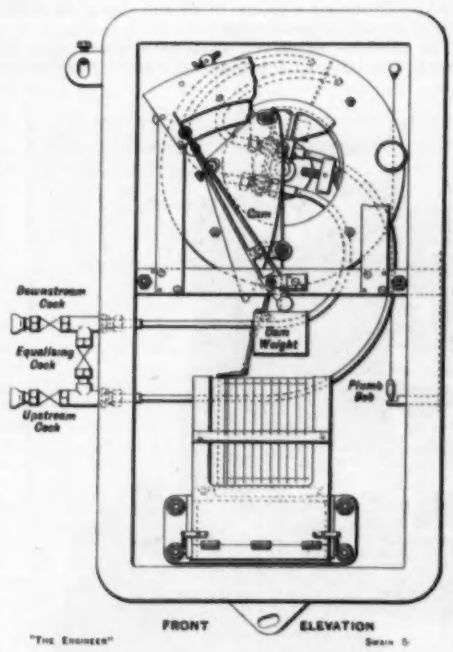


Fig. 116—Balanced Pitot Tube Recorder—Kent

from behind the pen and so can be cut off right up to the pen line.

Modifications of the instrument enable the flow to be recorded by a counter. The counter, chart and indicator readings may be transmitted electrically to a distant point.

The temperature controller illustrated in Fig. 117 has been produced for the purpose of measuring, recording, and controlling industrial temperatures to within an accuracy of plus or minus 1 deg. Fah., at temperatures up to 1000 deg. Fah. It is especially applicable to those cases in which high accuracy of

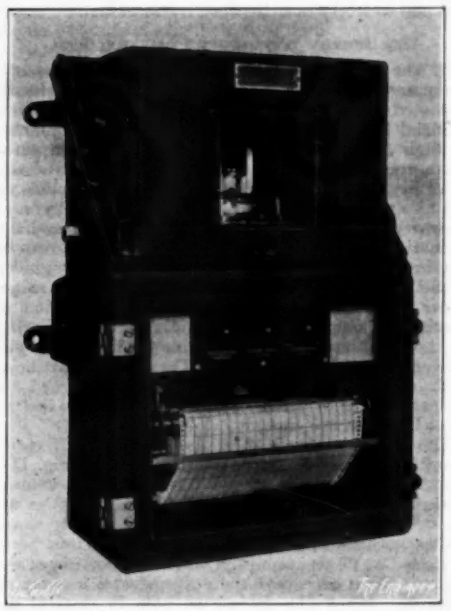


Fig. 117—Temperature Controller—Kent

control is essential, but in which there may be considerable time lag between change of conditions effected by the controller and a measurable change of temperature at the control point. The instrument overcomes the effects caused by time lag, and controls without hunting, by taking into account both the deviation from the standard temperature which it is desired to maintain and the rate at which return to this standard temperature takes place after the initial adjustments have been made. Both the deviation and the rate are measured every 20 seconds by means of a mechanism which is driven by a constant speed motor, the deviation being measured by the displacement of the balance point of a potentiometer slide wire, and the rate in terms of the out-of-balance current of the potentiometer. The circuits operating the controls are made by metallic contacts and are broken on a mercury switch, which eliminates damage to the contacts by sparking. The chart on which the controlled temperature is recorded is an exceptionally open one, a pen motion of 10in. corresponding to a change of temperature of 200 deg. Fah. The equipment also comprises an instantaneously acting mechanical clutch for making the desired amount of movement with precision. This drive consists of a continuously rotating high-speed worm and two worm wheels, the latter being thrown into engagement by solenoids actuated by the temperature-controlling mechanism and being, in turn, connected to the valve-controlling mechanism which regulates the supply of fuel or of circulating liquid. A special feature of the apparatus is that the galvanometer and other delicate parts of the control mechanism are placed in a case, which is both dust-tight and gas-tight.

Other exhibits on this stand included instruments for the gas-making industry, such as manometers and recorders, and a shunt gas meter, which, by measuring a part only of the main flow, gives an accurate measure of the whole at a moderate expenditure on apparatus.

Lacy-Hulbert and Co., Ltd.

A varied display of pneumatic tools and air compressing machinery was shown on the stand of Lacy-Hulbert and Co., Ltd., of Boreas Works, Beddington. An outstanding exhibit was the automatic electrically driven air compressor set which we illustrate in Fig. 118. The compressor itself is one of the firm's patented high-speed units, with roller bearings, a steel connecting-rod and an aluminium piston. The cylinder and valves are water cooled. It is direct coupled to a 3 B.H.P. motor and is complete with an

Fig. 118—Air Compressor Set—Lacy-Hulbert

air inlet filter and an oil and moisture separating vessel. The vertical air container is riveted and designed for a working pressure of 150 lb. to 200 lb. per square inch and tested to 300 lb. per square inch. An automatic switch controls the motor in accordance with the pressure in the air receiver. The unit is made in three sizes and outputs, with 3, 5, and 10 B.H.P. motors respectively.

Besides a range of vertical and horizontal high-speed compressors there were shown some examples of low-pressure compressors, a view of one of which machines we reproduce in Fig. 119. The details of these compressors follow closely those for the single-acting vertical compressors for duties up to 250 lb. per square inch, but for the lower pressures up to 35 lb. per square inch the cylinders are of larger diameter and the water jackets are dispensed with, only the cylinder covers being water cooled. The example shown has a designed capacity of 100 to 125 cubic feet of free air per hour delivered at a pressure of 15 lb. to 35 lb. The cylinder has a diameter of 275 mm. and a stroke of 180 mm. Among many designs of portable machines for working pneumatic tools and for spray painting, &c., we have chosen for illustration the small electrically driven set shown in Fig. 134, page 380. It is mounted on light rubber-tired wheels and the tubular base serves as both an air receiver and an oil separator. The compressor is driven by a 2 B.H.P. motor, and it has an output of 9 cubic feet of free air per minute delivered at 80 lb. per square inch pressure.

Another exhibit of more than usual interest was a portable petrol engine driven desiccator, which was originally designed by the firm some years ago for the Post Office authorities for drying out telephone cables, &c. It then took the place of a three-throw divers' pump mounted on a hand cart. The

latest type of machine which was shown at Olympia embodies the firm's patented horizontal air compressor, which is driven by a Boulton and Paul 3 B.H.P. petrol engine. Four cast iron cylinders are provided for holding calcium chloride in brass trays, through which the compressed air is passed and thus dehydrated on its way to the telephone cable. Between the compressor and the calcium cylinders is a small air receiver, which eliminates the moisture and oil. The machine is mounted on four

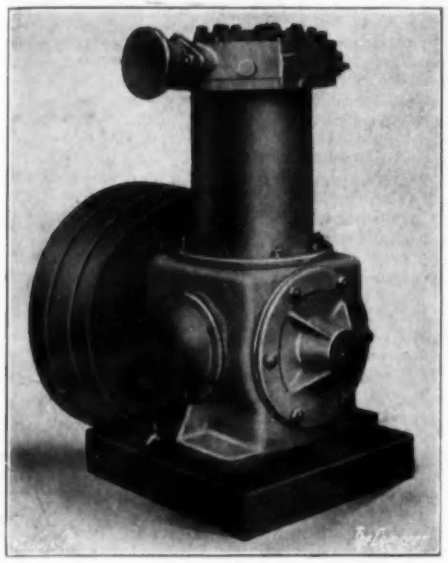


FIG. 119—LOW-PRESSURE AIR COMPRESSOR—LACY-HULBERT

light steel wheels fitted with springs, while a waterproof canvas canopy serves to protect the apparatus from the weather.

THE STREAM LINE FILTER COMPANY, LTD.

The principal new exhibit on the stand of the Stream Line Filter Company, Ltd., of 45, Horseferry-road, Westminster, S.W. 1, was a transportable filter for transformer oil, which we show in Fig. 121. It is intended for the smaller transformer stations, which it is expected will come into being as the grid scheme is established. The designed output of the unit is 100 gallons per hour of transformer oil, or 40 gallons or more per hour of switch oil, according to its condition. The principal dimensions of the set are given in our drawing, and the weight of the complete unit is about 12 cwt. As will be seen the plant comprises the following principal components, an electric heater, which raises the oil to be treated up to 85 deg. Cent., and a renovater of the firm's streamline edge filtration type, which works in conjunction with a vacuum receiver. The oil is thus exposed to both heat and vacuum in layers of infinitesimal thickness, thereby ensuring the removal of all traces of moisture. There is also a motor-driven, dry-vacuum pump, by which all vapour and gases are withdrawn and an oil delivery pump for discharging the clean dry oil. The set is mounted on a trolley and a sheet metal cover encloses all the units and the interconnecting pipe work. The heaters and the pumps can be inspected by lifting hinged doors, but when in actual operation only the oil control lever is exposed. The plant can be used to treat the oil of a transformer on load, or to withdraw oil from any source and return it in a clean condition without the need of any other pumps.

The firm has recently supplied sixteen larger oil filters, for the Central Scotland electrification scheme, and has in hand nineteen more sets for South-West England and Wales, also for India. In the acceptance trials of the filters for the Scottish scheme, it was found that the dielectric strength of the filtered oil was over 60 kilovolts, compared with 45 kilovolts, the guaranteed figure for the new oil, and 5 to 20 kilovolts for the unfiltered dirty oil.

Among other models shown on the stand, we have chosen for illustration—see Fig. 120—the streamline filter equipment for the treatment of oily bilge water, which has been supplied to British and foreign naval departments, and is installed on large liners, cargo ships and private yachts. Its

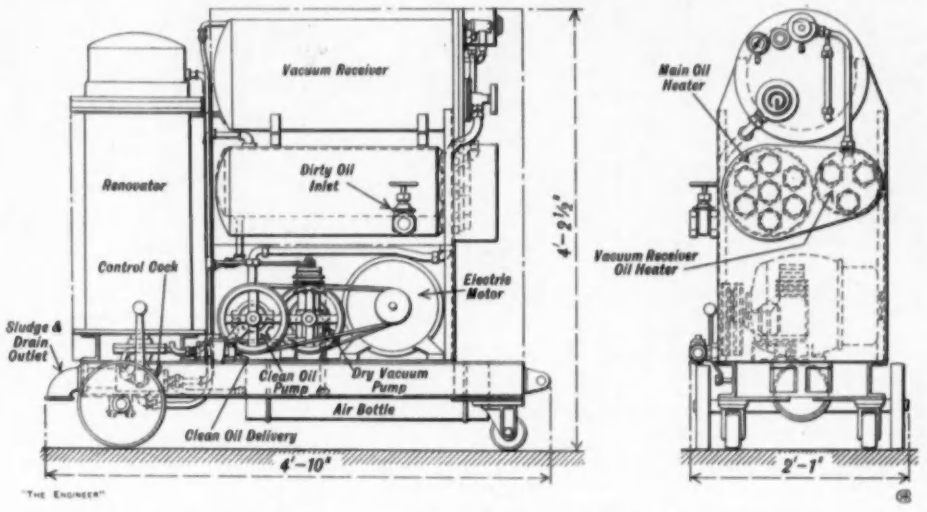


FIG. 121—PORTABLE FILTER PLANT FOR TRANSFORMER OIL—STREAM LINE FILTER

method of operation is clearly indicated in the illustration we reproduce.

THE CONSOLIDATED PNEUMATIC TOOL COMPANY, LTD.

There was a very wide range of pneumatic and electric tools on the stand of the Consolidated Pneumatic Tool Company, Ltd., of 170, Piccadilly, London, W. 1. Among them there was the pneumatic wrench—Fig. 133, page 380—which is typical of a new range of rotary machines that have been developed to overcome the inherent disadvantage of the piston type. Power is derived from a rotor fitted with vanes, so that there are no pistons, connecting-rods, valves, excentrics or excentric straps, and there is no crank shaft. The only inertia forces are those due to starting and stopping. The rotor is concentric with the rotor shaft, which ensures good running balance and freedom from vibration. The rotor with its vanes, generally four in number, revolves in a cylinder which is fitted with a steel liner. Suitable inlet and exhaust ports are arranged in the cylinder so as to get as even a distribution of air pressure as possible. The result is a very smooth-running machine with increased torque and power and less weight per horse-power as compared with the piston-type machines. The supply of air is controlled by a governor, which prevents the speed rising above a predetermined point when the load is thrown off, helps to prevent breakage of drills, taps and reamers, and reduces the air consumption. The vanes are made of a non-metallic material, which is practically unaffected by any moisture in the compressed air. Automatic lubrication of the rotor and vanes is effected by a lubricator in the casing of the machine. Grease fittings are placed on the gear and governor cases, and ball or roller bearings are used throughout. All gears are of heat-treated alloy steel of great strength. The parts of the machine are held together by through bolts.

The rotary wrench is powerful enough to pull up nuts of 1¼in. bolts absolutely tight. It is provided with a double-ended spindle, one end being used for tightening and the other for loosening nuts. No governor is provided on this rotary wrench, because, when loosening nuts, it is desirable to use the high speed so as to save time. Drills are made in various sizes, ranging from a capacity of ¼in. up to 1¼in. The ¼in. size is a particularly interesting little machine on account of its light weight and great power. Larger drills are of the side spindle type, in which the distance from the centre of the spindle to the outside of the machine is less than on any piston type drill, thus making them particularly suitable for work in close quarters. On these side spindle machines the feed screw is, of course, in line with the spindle.

There were also on this stand a number of pneumatic riveting and scaling hammers, road-making tools and rock drills, all of which are shown in operation, supplied by a 5½in. by 5in. C.P. vertical compressor driven by a Crompton Parkinson motor with Igranic control gear. There was also a display of Hicycle electric tools, for drilling, grinding, &c., which we have already described. A new example of this class is a drill specially designed for shipyard work, in which the drill centre is only 2¼in. from the outside of the casing.

SUPER-CENTRIFUGAL ENGINEERS, LTD.

On the stand of Super-Centrifugal Engineers, Ltd., of 101, Grosvenor-road, London, S.W. 1, there was shown a representative display of the Sharples super-centrifugal separators and clarifiers, which have been

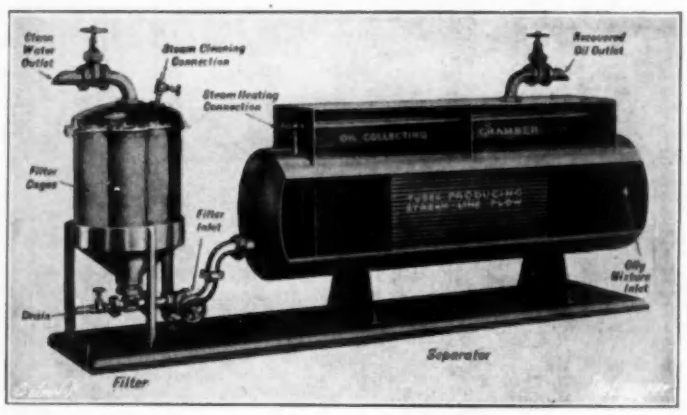


FIG. 120—SEPARATOR FOR OILY BILGE WATER—STREAM LINE FILTER

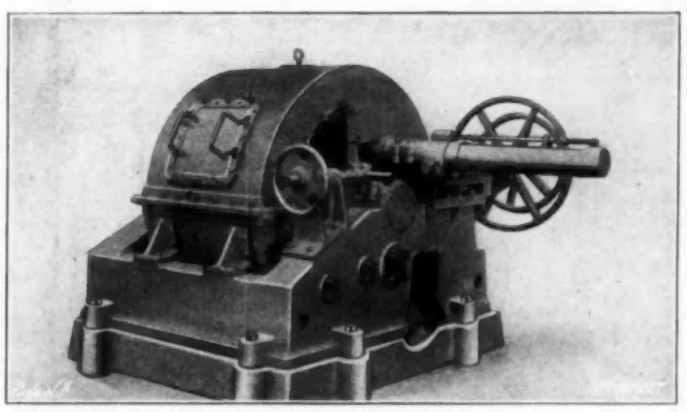


FIG. 122—BULK CENTRIFUGE—SUPER-CENTRIFUGAL ENGINEERS

designed to meet the requirements of marine service as well as an increasing range of commercial manufacturing processes. The working principle of the Sharples machine, with its long bowl, having an approximate length of 30in. and a diameter of 4in. and running at 15,000 to 17,000 r.p.m., was fully described in our issue of September 20th, 1929. The design has been developed and this year the firm exhibited examples of its duplex pattern new high-capacity totally enclosed fume-proof separator. It is driven by a four horse-power, 3500 r.p.m. B.T.H. motor, and its output is from 2 to 4 tons of oil per hour. The totally enclosed machine makes it possible to treat oils at high temperatures, avoiding the escape of any vapour to the surrounding spaces. Thirteen machines of this pattern are fitted on the White Star motor liner "Britannic," while a similar number will be installed on the sister vessel the "Georgic." Another machine shown on the stand, which we illustrate in Figs. 122 and 123, was the Sharples bulk centrifuge, which has been produced in

order to overcome many of the difficulties which are encountered in the separation of liquids from solids in cases where the solid content of the mixture is relatively high. The machine, as will be seen from our illustrations, consists of a 36in. diameter basket, which revolves at 1250 r.p.m. The basket can be perforated or non-perforated, so that either filtration or sedimentation can be used to effect the separation. Our drawing shows the arrangements for feeding and traversing the cutting knife, which slices off the dried material and delivers it to the discharge chute. This machine is, we learn, now in use in several factories

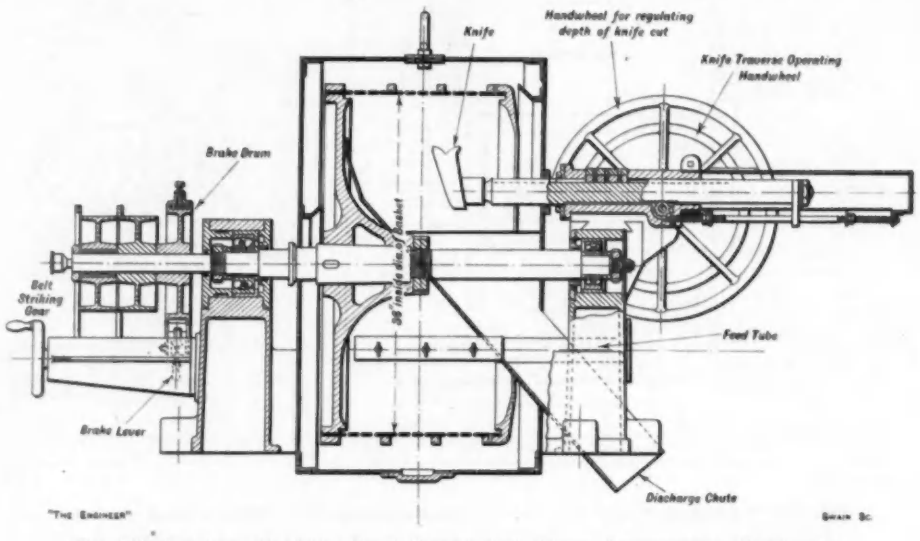


FIG. 123—SECTION THROUGH BULK CENTRIFUGE—SUPER CENTRIFUGAL ENGINEERS

for the purpose of drying crystalline solids, the dehydration of sludges, and the bulk treatment of tars, clays, starches, &c. The machines are built in a number of sizes and to various specifications, the materials of construction varying according to the nature of the particular product to be treated.

British Separators, Ltd.

Various types of their centrifugal separators were shown by British Separators, Ltd., of York. The one we have chosen for illustration in Fig. 124 is a self-contained plant, comprising a type 20 separator fitted with a dual purpose bowl, which allows the machine to be used either as a purifier or as a

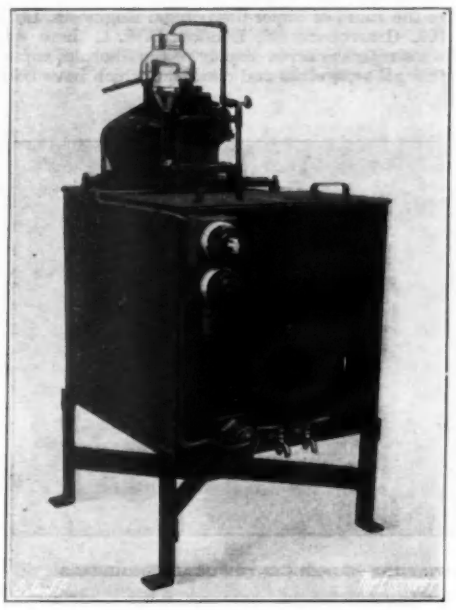


FIG. 124—SELF-CONTAINED SEPARATOR PLANT—SEPARATORS

clarifier, driven by a ¼ H.P. motor. The separator itself is mounted upon a tank divided into two compartments, each having a capacity of about 25 gallons. One is provided for clean oil and the other for dirty. A rotary gear pump is fitted for withdrawing the dirty oil and delivering it to the separator. On the discharge side of the pump there is a feed control valve which, when closed, causes the oil withdrawn from the dirty oil tank by the gear pump to be by-passed back into the dirty oil tank *vid* a relief valve. A three-way cock on the discharge side of the separator allows the oil to be delivered into either compartment as required. A switch fixed on the side of the tank controls a 2500-watt electric immersion-type heater fitted in the dirty oil compartment, giving three heats, and above this switch is another controlling the motor for the separator. It will be seen from the engraving that the tank is arranged with removable lids for inspection and that drain cocks are provided. This self-contained plant is designed to be suitable for treating crank case oils.

John Fowler and Co. (Leeds), Ltd.

In our issue of July 24th last we described and illustrated a new type of compression-ignition airless-injection heavy oil engine of British design, which was exhibited at the Royal Agricultural Show at Warwick. It was also shown at Olympia. This new range of oil engine is built in five sizes, having one up to six cylinders, with designed outputs of 10 up to 90 B.H.P. The engines all have a cylinder bore of 120 mm., or 4¾in., with a stroke of 180 mm., or 7in., and the one, two, and three-cylinder models run at 1000 r.p.m., while for intermittent work, such as transport duty, this speed can be increased up to 1500 r.p.m. in the four and six-cylinder sizes. The models exhibited at Olympia included the six-cylinder 90 B.H.P. engine, illustrated in Fig. 125, and a two-cylinder engine directly coupled to a 12-kW dynamo. A noteworthy feature in the design is the use of the Fowler patented cavity piston, which, it is claimed, gives a smooth running engine without any sacrifice of efficiency. The test curves we have

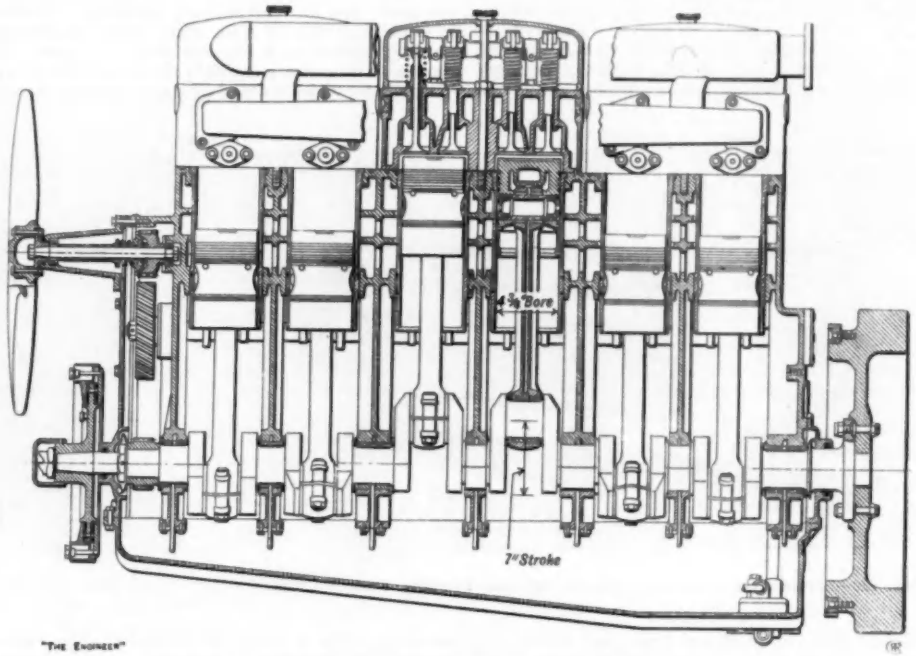


FIG. 125—90 B.H.P. COMPRESSION-IGNITION ENGINE—FOWLER

inspected show very flat torque characteristics over a wide range of power with a fuel consumption ranging from 0·42 up to 0·45 pints of oil per B.H.P. hour. The engine has proved easy to start by hand, and automatic starters are only required for the four and six-cylinder engines. Although the bearing dimensions are large, the weight of the engine is small, and including the fly-wheel it works out at only 23 lb. per B.H.P. for the six-cylinder unit. All the auxiliary items, such as the Bosch fuel pumps, the electric generator and starter, the vacuum pump and oil cleaner, are fitted on one side of the engine, and the sump is so designed that it can be removed without dismantling any auxiliary parts. In the case of a lorry drive with a forward control the arrangement is such that a large clearance is given. A small detail, worthy, however, of note, is the geared fan drive, which incorporates a spring-loaded friction clutch, the assembly being so designed that it can be removed for adjustment by undoing four nuts.

Henry Hughes and Son, Ltd.

Among the exhibits of Henry Hughes and Son, Ltd., of 59, Fenchurch-street, E.C., was the Holmes Master Compass equipment, comprising a standard compass of special design mounted in a compensated binnacle and adapted to operate any required number of repeater compasses at distant stations, the repeater compasses being operated by the master compass in steps of one-sixth of a degree. The repeater compasses are equipped with internal lighting and a rheostatic dimmer, and may be fitted with an azimuth mirror. Standard repeater compasses are supplied in several patterns for steering, taking bearings from the bridge wings, for radio direction-finding, and for tell-tale indicating. The repeater mechanism may be incorporated in any device which requires the control of the master compass, such as a course recorder, an automatic pilot, and particularly the Holmes Path Indicator, shown in Fig. 126. The flexibility of the system permits of the choice and use of any combination of these accessories, the two main instruments required for ensuring the straightest courses, and economical navigation being, however, the Master Standard Compass and the Path Indicator which enables the helmsman to keep the vessel on the prescribed track. If the vessel should depart from this track, the instrument records the actual distance away from the track to port or starboard. The compass alone, it is pointed out, cannot do the whole job of path indicating, because it is solely a directional instrument, and does not record the distance a vessel travels away from its prescribed track, whenever its direction is changed.

The Path Indicator which is controlled by the Master Standard Compass is placed in front of the steering wheel, and is mounted in a sealed waterproof case, together with the steering repeater compass. As shown in Fig. 126, it has two dials, the repeater compass dial and the path indicator dial. After the ship's course has been determined and the ship begins its journey, the instrument may readily be set by the navigation officer to indicate the ship's position in relation to the prescribed track. From the indications of the repeater compass the vessel is then steered in the usual way, but at short intervals the helmsman also observes the indications of the Path Indicator, in order to ascertain whether the vessel is being kept upon the prescribed track, as well as on the proper heading. The Path Indicator has two hands, one a large star-shaped hand and the other a smaller hand, similar to a hand of a clock. The star hand, which is sensitive and active, points the way either to port or starboard, that the vessel must be steered to bring it back to the prescribed track, whenever it departs from that track. It indicates a departure from the track of even a few yards, and thus ensures a straight and economic course by the elimination of the steering errors that occur when steering is done by the compass alone. The small hand, which is provided for the navigating officer and which moves more slowly than the star hand and records the dimensions of the larger errors that may occur, indicates when the steering errors have not been corrected by the helmsman or when the vessel has departed from its track to execute some manœuvre.

The dimension of the distance of the vessel away from the prescribed track, either to port or starboard, is plainly shown by the small hand in decimals

of a mile, and this information enables the navigating officer to return the vessel to its proper track or to use it for correcting the position by dead reckoning. The distance away from the prescribed track resulting from the accumulation of the innumerable deviations made by a vessel in a seaway cannot be estimated. Often it amounts to many miles a day, and this steering error, the makers of the new instrument explain, constitutes a risk and considerable expense. Apart from the steering error, contingencies arise in manœuvring, and mistakes are sometimes made causing departures that the compass does not record, and regarding which the navigating officer has no information, but all such contingencies are taken care of by the new instrument.

The Path Indicator is controlled by a repeater compass and a small time motor, which runs continuously at a uniform speed. The instrument is set with the aid of two knobs. By means of one knob a red pointer is moved over the face of the repeater compass card, and set upon the prescribed compass course, whilst by means of the other knob the hands of the path indicator dial are set at zero, which indicates that the ship is on the prescribed track. When the ship is pursuing a more or less devious course, the distance away from the prescribed track, either to port or starboard, is computed by an automatic integrating mechanism. The sine of the angle of departure from the prescribed track as set off by the repeater compass is integrated with time, or, more correctly speaking, with the uniform speed of the time motor. In this integration the uniform speed of the time motor represents a ship's assumed uniform speed at a rate of 1 knot and the dial is calibrated

FIG. 126—PATH INDICATOR—HUGHES

accordingly. The dial thus shows the distance in miles for an assumed speed of 1 knot. It therefore follows that the actual dimension of this distance in miles for any other uniform speed, such as for a ship travelling uniformly at the rate of 12 knots, may be found by simply multiplying the dial reading by the ship's speed in knots. The dimension, as shown by the small hand, concerns the navigating officer only and not the helmsman. The star hand is for steering purposes solely, and points the way for the helmsman that the vessel must be steered to bring it back to the prescribed track.

Reverting to the Master magnetic compass, the method by which the various repeaters are controlled is based upon an entirely new principle, and does not disturb or interfere with the magnetic directional element. In general, the compass is similar to the most approved type of present-day liquid standard compass. The bowl is hung in roller-bearing gimbals from a frame which is rotatably mounted upon a vertical ball-bearing spindle. This arrangement permits the frame, together with the gimballed compass bowl, to be smoothly revolved in the horizontal plane, either way and concentrically around the compass card which remains stationary in the magnetic meridian, supported upon its own pivot inside the bowl. The frame carrying the compass bowl is connected by a vertical driving shaft and reduction gearing to a reversible electric azimuth motor at the bottom of the binnacle.

In addition to the magnetic compass card contained in the bowl, a large metal compass card is attached to the revolvable frame outside and clear of the gimbals on a level with the top of the compass bowl and concentric therewith. This large card is called the master card, to distinguish it from the magnetic card. The master card revolves with the compass bowl and is read against a lubber line inscribed upon the stationary vertical bracket. The compass bowl, together with the master card, are revolved upon their spindle by the azimuth motor whenever they are turned by the turning ship, but in a contrawise direction, so as to maintain the bowl and master card stationary in azimuth and synchronous with the magnetic card. Thus the master card behaves exactly like the magnetic card and is therefore an electric compass, capable of transmitting its movements to distant stations.

The liquid in which the magnetic card is suspended in the compass bowl is ionised with an acid and is utilised as a high resistant electrical conductor, the control of the repeater system being effected by the variations of the electrical resistances of two liquid paths in A.C. circuits, which pass through the compass bowl and operate a differential relay upon the control panel. The paths lie between electrodes fixed to the bowl and electrodes attached to the magnetic card. The interior of the bowl and the magnetic card float are made of insoluble insulating materials and metals. The compass bowl is equipped with four "bowl electrodes" led in through insulator tubes and equally spaced around the bowl, the vertical ends being bare, and clear of the compass card. The magnetic card carries two parallel insulated wires with exposed ends bent into the vertical, and forming four "card electrodes" equally spaced around the edge. The card can rotate freely and the bowl and card electrodes pass each other with a clearance of about $\frac{1}{16}$in. An additional wire, to serve as a lubber line, is mounted inside the bowl. The bowl electrodes are suitably connected to the external portion of the circuits. Each of the two A.C. circuits passing through and across the compass bowl includes an A.C. generator, a pair of bowl and card electrodes, two short high-resistant liquid gaps between the two pairs of bowl and card electrodes, and one of the magnet coils of a Holmes differential A.C. relay. The differential relay is on the control panel, and is controlled by the variations of the electrical resistances of the two circuits within the bowl.

The system is so arranged, that when the north point of the magnetic card is opposite to the lubber line within the bowl, the card electrodes are opposite their respective bowl electrodes, and the two electric paths have equal resistances, the current in the two paths being led to the differential relay. When the electric balance is disturbed by a rotation of the revolvable bowl about the magnetic card, the variations in the current intensities of the two circuits close the differential relay, which, in turn, operates one of the two electro-magnetic switches that control the reversible azimuth motor that drives the bowl. As soon as the bowl moves through the slightest angle in either direction away from the magnetic card, as when carried by the turning vessel, the electrical balance in the bowl is disturbed, the relay operates one of the switches, the electric motor is started, and the bowl is rotated back to its initial relationship with the magnetic card. Electrical equilibrium is then restored, and complete synchronism is re-established between the bowl, the master card, and the magnetic card. The lubber line inside the bowl is used as an index point to show when the bowl and the master card synchronise with the magnetic card. The ship's heading is indicated by the large master card that revolves with the bowl, and is read against the external stationary lubber line. Thus, precise control of the external apparatus is effected by the sensitive magnetic card without harnessing it or disturbing it electro-magnetically. The compass card lies free and quiescent in the magnetic meridian. Owing to its inertia, the card is undisturbed by the rapidly alternating magnetic field superimposed upon the earth's field by the A.C. The function of the card in the transmission system is merely to carry the light metallic conductors which provide the two low-resistant paths for the A.C. which operates the differential relay.

As it is essential that the Master Compass must be free from electro-magnetic influences, A.C. is employed in the relay control circuits that pass through the bowl, and also for operating the azimuth motor. The current is obtained from a small 200-watt, 75-volt, 50-cycle rotary converter, which is run off the ship's D.C. mains. The repeater compasses are electrically operated by D.C. taken off the ship's mains through appropriate resistances, a positive step-by-step transmission being effected by means of a rotary transmitter connected to a suitable part of the reduction gearing between the azimuth motor and the revolvable compass bowl.

RUSTON-HORNSBY, LTD.

The engine shown on the stand of Ruston-Hornsby, Ltd., of Lincoln, was a 275 B.H.P., 165-kW, five-cylinder marine auxiliary generator set with a bore of 12in. and a stroke of 17½in., designed to run at 300 r.p.m. It was fully described in our issues of September 9th and July 1st, 1927, but is of present interest as it represents a design which has been supplied to several prominent shipowners in recent years, more than thirty-two sets now being in operation on different ships. As a typical example of the performance of these engines we may refer to the four sets installed in the motor ship "Dunster Grange," belonging to Houlder Bros. and Co., Ltd., which have been in operation since January 23rd, 1928, when the ship was taken over from her builders. The approximate time run by each engine has been about 11,000 hours, and from the engineers' reports we have inspected these engines have been very free from running troubles. A feature of the design is the close governing, which allows a load of 50 per cent. to be safely thrown on or taken off. Ruston engines are supplied for main propulsion or auxiliary work in eight sizes from 80 up to 330 B.H.P.

Among the smaller engines which were exhibited on the adjoining stand of the Ruston-Lister Marine Company, Ltd., of Imperial House, Kingsway, W.C. 2, we have chosen for illustration, see Fig. 137 on page 380, a 38 B.H.P. high-speed engine, which has a bore of 4¼in. and a stroke of 5½in. and is designed to operate at 1000 r.p.m. It is the largest of a range of four units with one, two, three, and four cylinders, all of which can, if desired, be supplied with a 2 : 1 reduction gear giving 500 r.p.m. at the propeller. The engine works on the four-stroke cycle and embodies the Lister patented combustion chamber. Its consumption is from 0·43 lb. to 0·48 lb. per B.H.P. per hour. Various other engines were shown, including a four-cylinder 64 B.H.P. four-stroke engine complete with reverse gear and all auxiliary pumps. The fuel system of this engine is of the Ruston pattern with the firm's patented pump and atomisers, and the fuel consumption for the larger sizes of engine is from 0·38 lb. per B.H.P. hour. The same type of engine as above described is made in both three and six-cylinder sizes, with designed outputs of 48 and 96 B.H.P. at the same running speed of 900 r.p.m.

STOTHERT AND PITT, LTD.

Among the many rotary displacement pumps now on the market, that manufactured by Stothert and Pitt, Ltd., of Bath, is one of the most interesting. Unlike many other types, it is not a "disguised" reciprocating pump, for its moving parts all truly rotate. Many examples of these pumps were shown

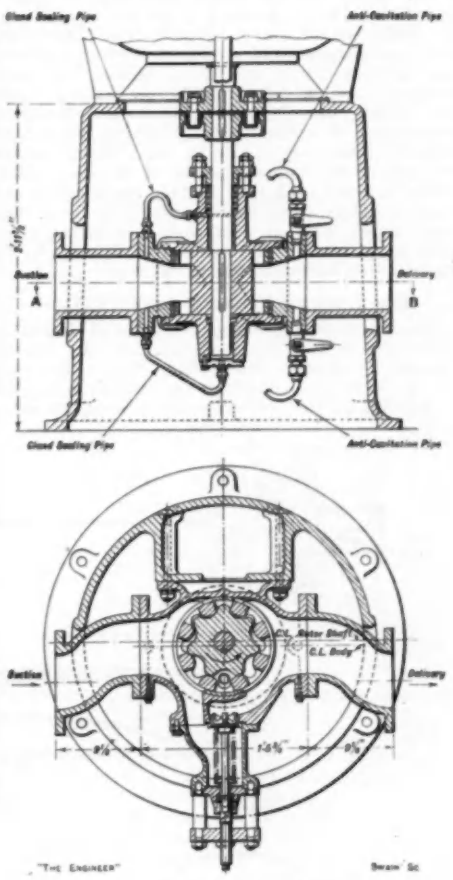


FIG. 127—VERTICAL SPINDLE ROTARY PUMP—STOTHERT

on the stand taken by the firm at Olympia, suitable for a variety of purposes. The nature of the design can be followed from the drawing, Fig. 127, which we reproduce above. The parts of the pump are a body, a body liner, glands and inspection covers, an inner rotor keyed to the driving shaft and an outer rotor running in the body liner. Two types of pumps are made by the firm, known respectively as the "three-four" and the "seven-eight." These figures refer to the number of lobes on the inner rotor and the number of recesses in the outer. The pump shown in the drawing is of the "seven-eight" type. It will be observed that the rotors are mounted excentrically the one to the other. In consequence, as the inner rotor revolves the spaces between its lobes and the outer rotor, which is driven by it, increase and decrease, thereby creating a pumping action. The outer rotor is provided with eight ports, one opposite each recess, and these provide passages for the liquid and, at the same time, acting in conjunction with the passages in the casing and the body liner, act as valves, shutting and opening at the correct moments. The pump to be seen in the drawing is equipped with gland-sealing pipes and two other pipes by-passing a little of the liquid from the delivery side back into the pump to counteract any tendency

towards cavitation. We observed on the stand that this anti-cavitation device was very effective.

The pump shown in the drawing is designed for attachment to a vertical spindle motor, and such an arrangement was shown on the stand. It is direct coupled to the motor, and is suitable for use for supplying forced lubrication, or for fuel transfer purposes. The unit shown had an output of 20 tons per hour against a pressure of 30 lb. per square inch, and was in operation on the stand.

In Fig. 140 on page 380 we illustrate a unit recently developed for discharging or loading fuel oil into or out of road wagons, which was exhibited on the stand. It consists of a specially designed pump connected through a clutch mechanism to a four-cylinder petrol engine, made by Henry Meadows, Ltd., of Wolverhampton. The pump is constructed with two-way cocks formed in the pump body, such that the direction of flow of the oil in the pipe line can be reversed without changing the direction of rotation of the pump and engine. The speed of the unit can be varied between about 600 r.p.m. and 1200 r.p.m. to allow for different oil viscosities, and the pumping capacity is about 23 tons per hour at maximum speed. The main castings in the unit are made of aluminium, and the total weight is approximately 475 lb.

The Drawing Office Material Manufacturers' and Dealers' Association.

A very complete range of drawing-office machines and instruments was shown on the stand taken by the Drawing Office Material Manufacturers' and Dealers' Association. The membership of this Association stands at over 150, but the individual names of the various manufacturing firms did not appear. The exhibits were arranged to show the full range of articles which the members of the Association could produce, and included electric copying machines, washing and drying machines, dyeline developing machines, and a large display of drawing tables and other drawing-office furniture. Surveying instruments of various kinds, drawing instruments and slide rules were also to be seen. Tracing cloths and papers and various grades of drawing papers, which demonstrated that British materials of this nature could be prepared of as high a grade as those from abroad, were on view, and, in addition, prints made by a variety of processes of interest to the engineer were demonstrated on the stand.

The Turbine Furnace Company, Ltd.

There were two full-sized examples of grates for Lancashire boilers on the stand of the Turbine Furnace Company, Ltd., 238B, Gray's Inn-road, London, W.C. 1, one of which we illustrate in Fig. 128.

The Turbine furnace bar scarcely needs introduction to our readers, as it has been described in The Engineer before, but it may be explained that it is a hollow, longitudinal, cast iron trough, of which five are needed to make up a standard 3ft. wide grate. Into each trough there is forced a supply of air by steam jets, which are said to consume no more than 2½ to 3 per cent. of the steam produced by the boiler. The surface of the grate is composed of a large number of very small and short transverse interlocking slotted fire-bars, or "elements," fixed across the top of the troughs. Thus, for a 5ft. 6in. by 3ft. grate, as commonly used for internally fired boilers, each trough has forty-five small transverse bars with nine air spaces corresponding to 225 small bars and 2025 spaces. Further, these elements have a sloping projecting portion like the blade of a turbine, which dips in the air blast in the trough below, and diverts a small volume of air, corresponding to the particular aperture, up through the fire.

In the new arrangement, which we illustrate, there is an extension grate at the back, for use when the fire is being cleaned. It can be seen in the illustration just in front of the bridge. This grate is built up of V-shaped hollow bars filled with fire-brick blocks, and arranged to leave narrow spaces for the passage of air. When it becomes necessary to clean the fire the good part is pushed back on to this extension grate and the clinkers are pulled out at the front. During this process the dampers shown enable the draught to be diverted to the extension grate, where the fire burns vigorously. Fresh coal is then thrown on to the main grate and the fire drawn back again. The fire-brick in the extension acts as a recuperator, and we are told that the fires can be cleaned without producing smoke, or losing steam pressure, while the work is less arduous than the usual system.

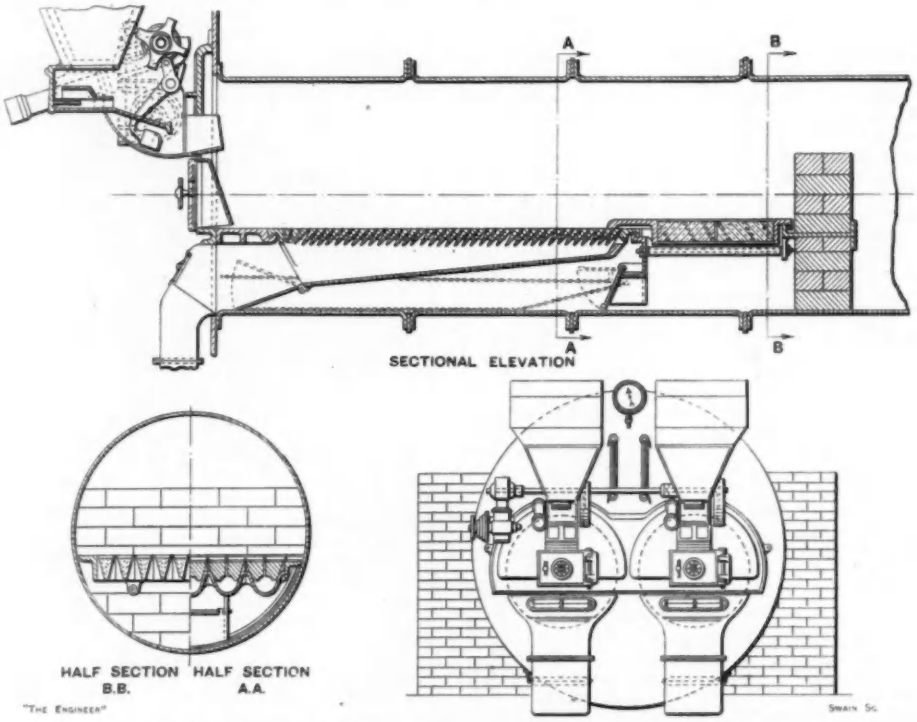


Fig. 128—Grate for a Lancashire Boiler—Turbine Furnace

Alfa-Laval Company, Ltd.

A special feature of the exhibits on the stand of the Alfa-Laval Company, Ltd., of 34, Grosvenor-road, London, S.W. 1, was the new type of marine oil purifier, which we illustrate in section in Fig. 129. It incorporates a new design of bearing for the centrifugal spindle, which enables the machine to run under adverse conditions at sea. In order to demonstrate the ability of the purifier to run smoothly and quietly even when subjected to a rolling motion, one 600-gallon per hour machine was shown in motion at Olympia on a rolling platform. Fig. 129 shows clearly the construction. The drive is by a B.T.H. horizontal motor directly coupled to the machine through the medium of a clutch, which is so constructed as to allow the bowl to be automatically accelerated within a reasonable period without imposing any overload on the driving motor or transmission mechanism.

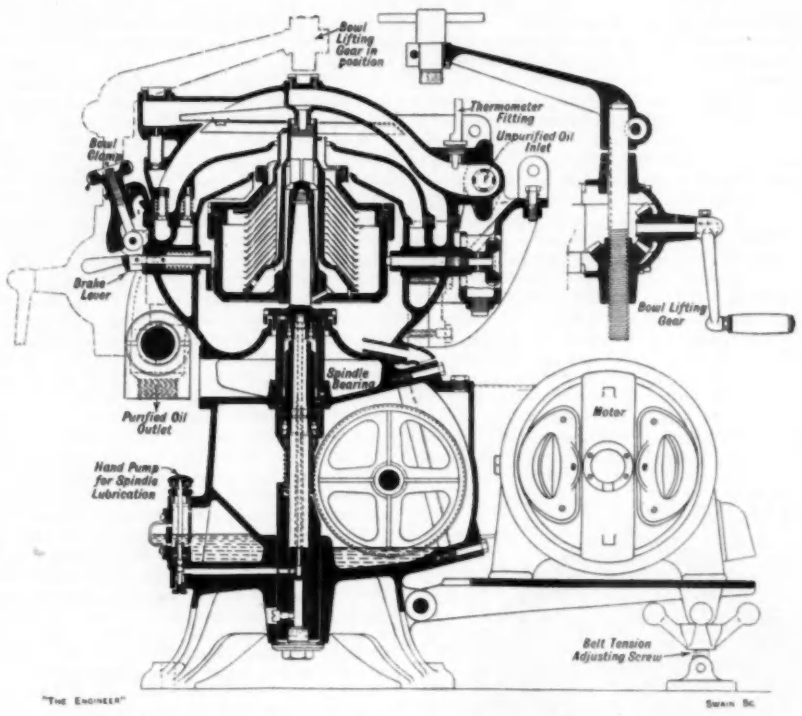


Fig. 129—Enclosed Marine Pattern Oil Separator—Alfa-Laval

For the purification of transformer and insulating oils a range of non-aerating machines was shown, one such machine being equipped with a vacuum attachment so that the dissolved gases and water are removed under vacuum during the purification process.

We show in Fig. 135 on page 380 a horizontal non-aerating oil purifier. As will be seen from the engraving, the centrifugal spindle is belt driven by a motor mounted on the top of the machine, and arrangements are made so that by throwing back the belt guard and dropping down the bowl cover the bowl can be quickly removed. A pump attached to the machine forces the liquid to be purified through the hollow shaft, and after centrifugal clarification it leaves the machine at the opposite end of the shaft. The pump has a designed lift of 10ft. to 12ft. and is constructed to deliver the purified oil up to a height of 15ft. to 20ft. This particular machine is specially recommended for the purification of the insulating oil for high-voltage transformers, and it has also been applied on oil-electric locomotives for the cleaning of lubricating oil.

Tangyes Ltd.

Two new oil engines were exhibited by Tangyes Ltd., of Cornwall Works, Birmingham. We illustrate one of these in Fig. 138 on page 380. It is a three-cylinder vertical model, develops 200–240 B.H.P. at 500 r.p.m., and was shown coupled to an E.C.C. generator.

The engine, which can be run at 600 r.p.m., if such a speed is required, runs on the four-stroke cycle, is totally enclosed, and has forced lubrication to all bearings. As can be seen from the engraving, it has a particularly neat appearance. The cam-shaft is situated at the top of the crank case and is totally enclosed in a cast iron casing, fitted with covers, which does much to reduce noise. A separate fuel pump is provided for each cylinder, and all are placed inside the casing enclosing the cam-shaft. In this position the advantage of short pipes between the fuel sprayers and the pumps is attained. Two exhaust valves are fitted to each cylinder. The combustion space is hemispherical and the sprayer is situated in the centre of the cylinder head. The controls are mounted at the fly-wheel end, a single lever sufficing for starting, running and stopping the engine, whilst a hand wheel, mounted on the panel carrying the lever, provides a speed control for a variation of 5 per cent. in either direction. The makers claim that the engine can be started and put on load in less than 30 seconds. An air bottle with a capacity of 16 cubic feet, will give ten starts when charged to an initial load of 350 lb. per square inch. A load indicator is fitted to the engine, so that the operator shall know the conditions under which it is running, even though the electrical instruments

are some distance away, while a device is incorporated by which, if the engine is accidentally overloaded, or a piston or other part commences to seize, the fuel supply is cut off. The engine exhibited weighed about 8 tons, but when lightness is essential, the weight can be reduced to 6½ tons by fitting a steel stator to the generator and by using a fabricated base and a lighter construction in the main framing.

Besides the engine described above, a new single-cylinder high-speed oil engine, developing 8 B.H.P. to 10 B.H.P. at 1000 r.p.m. to 1200 r.p.m., coupled to a generator and a compressor, was also to be seen on the stand, while a range of pumps for a variety of purposes was also shown.

The Rotary Air Compressor Company, Ltd.

On the stand of the Rotary Air Compressor Company, Ltd., of 12, Victoria-street, Westminster, there was shown a Demag rotary compressor, of the two-stage type, designed to deliver 400 cubic feet of free air per minute against a pressure of 100 lb. per square inch, arranged for direct-coupling to a standard high-speed motor. The machine—see Fig. 130 below—was fitted with a mechanical lubricator and the firm's patented unloading attachment.

Some smaller rotary compressors of the same type were also shown, together with vacuum pumps, while, in addition, there was exhibited a patented water alarm, which has been designed for use in

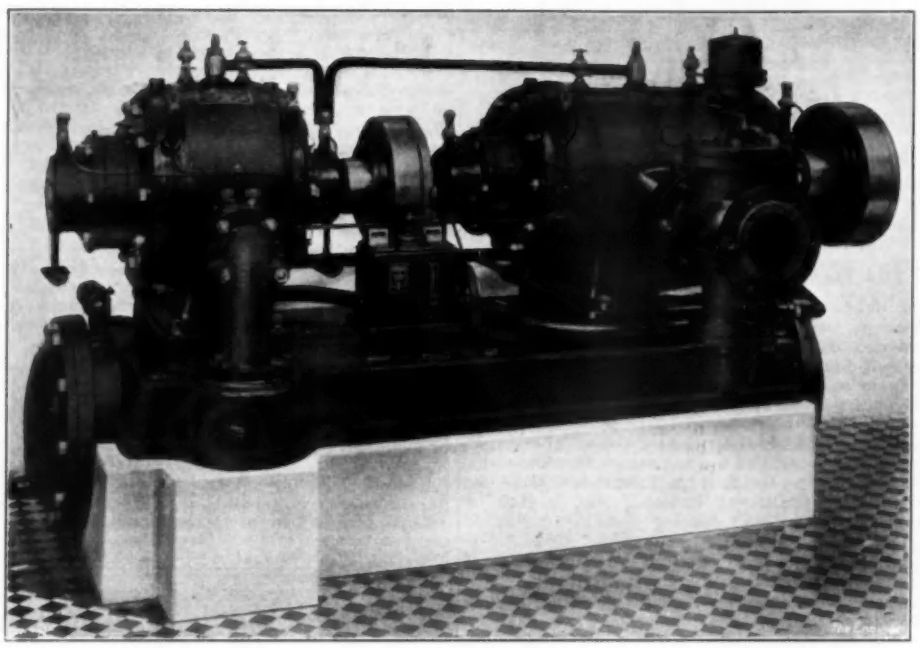


Fig. 130—Two-Stage Air Compressor Set—Rotary Compressor

connection with air compressors, internal combustion engines, or other plant, in which the failure of the water supply has to be guarded against. Another exhibit was a simplified type of air meter, constructed for capacities up to 220 cubic feet per minute. The meter is robustly constructed, and is particularly intended for tests in which a check has to be kept on the efficiency of various components, such as pneumatic tools. It can, however, be employed to check the outputs of compressors. It has been developed chiefly for the use of contractors and other users of compressed air plant, to meet cases in which the ordinary type of air meter is of too delicate a construction, besides requiring different sized orifices for making tests on various classes of plant.

Tensometer, Ltd.

The small testing machine, Fig. 136 on page 380, was exhibited by Tensometer, Ltd., of 73, Southampton-row, London. This machine tests a specimen with a cross-sectional area of one-fiftieth of a square inch, and gives the yield point, ultimate tensile strength, breaking strength, elongation, and reduction in area. It is capable of stressing a specimen up to 100 tons per square inch. A Brinell testing machine is also incorporated in the design. For tensile testing, the small specimen is placed between the chucks to be seen in the centre of the machine. The load is applied by hand by means of a handle which works through a nut and screw mechanism upon the end of a lever working upon the specimen with high mechanical advantage. Behind what might be termed the fixed headstock of the machine, as opposed to the tailstock, which is moved by the handle, there is a steel beam which is slightly deflected when the load is applied. Between the beam and the chuck there is a small tank containing mercury, some of which is displaced, when the beam is deflected, into a glass tube. The position of the mercury in this tube is a measure of the load, and a scale reading directly in terms of stress is laid alongside it. A cursor can run along the scale to make the reading more accurate.

The engraving shows an automatic recorder fitted to the apparatus. It consists of a drum rotatable, like that of an indicator, about its own axis, and mounted above it a pointer connected to the cursor on the mercury scale. The card from the drum is connected to the outer end of the lever through which the load is applied. The pointer does not draw the graph, but the operator at suitable intervals depresses it, and "pricks out" the curve. In use, the handle is turned until the load is just taken by the chucks, and the pointer then adjusted to be exactly over the origin point of the graph. By means of a small thumbscrew, the end of the mercury column can be adjusted to coincide with the reading of the cursor. A load is then applied by means of the handle, the cursor moved to coincide again with the end of the thread of mercury, and a point pricked out on the graph, the proceeding being repeated at convenient intervals, according to the nature of the test.

For making the specimen required special gauges are supplied, and in case any error may have been made there is a taper gauge, by the use of which the true diameter of the specimen may be measured, when by reference to a chart the readings of the machine may be corrected to allow for the error. If the percentage elongation is required, the specimen, before being broken, is placed in a special box, the cover of which when tapped with a hammer causes the punches to put pop marks in the enlarged ends. After breaking, it is replaced in the box and the percentage elongation read off from a scale. The reduction in area is measured by passing the end of the broken specimen between the jaws of a taper gauge, a reading being obtained at the point where the specimen will move no further.

For a Brinell test the specimen is placed at the back of the machine. The ball, of 5 mm. diameter, is fitted in such a way that the load is transmitted to the beam of the instrument and a reading is given on the mercury scale. A point is marked on the scale giving the correct Brinell load for this size of ball. The Brinell number is then found in the usual way by measuring the diameter of the impression with a microscope. By means of special attachments the machine can be used for a bend test or for taking an autographic record of a notched bar test.

A number of advantages are claimed for the machine by Tensometer, Ltd. The cost is low, relative to that of a full-size machine, while the specimens are simple and cheap to produce. In addition, on account of their small size, they can be obtained from small parts from which a full-size specimen could not possibly be cut. The machine is therefore of considerable use for testing parts which have failed from some cause in service. Although this fact constitutes a considerable advantage, it must, however, be remembered that it is not the main feature of the machine, which was designed to do more cheaply and rapidly what the full-size testing machine can do. It is claimed that tests can be carried out very rapidly, and since the machine is small enough to be easily portable, they may be completed in any convenient place.

The tensometer testing machine was invented by Mr. Hounsfield, and is made for Tensometer, Ltd., by the Birmingham Tool and Gauge Company, Ltd.

Kelvin, Bottomley and Baird, Ltd.

One of the most interesting exhibits on the stand taken by Kelvin, Bottomley and Baird, Ltd., of Glasgow, was the "Pneumercator" hotwell gauge. There are certain difficulties connected with obtaining at a distance a reading of the water level in a hotwell, arising chiefly from the varying degree of vacuum occurring in the vapour space above the water level. The method employed by the firm to overcome the difficulties is illustrated in Fig. 131. Essentially, it consists of a mercury "U" tube balancing the head of water in the tank against a fixed head. The arms of the "U" tube are connected one to the bottom of the tank and the other to a cup near the top. By means of a hand pump and cocks on the pipe lines, water may be drawn from the bottom of the tank and pumped up to the cup near the top. As this cup, the water in which constitutes the fixed leg of the balance, is situated within the tank, variations of the vacuum therein will have no effect upon the balance. The reading of the water level is taken on a scale against a gauge glass on one side of the "U" tube.

Another exhibit, the Lumsdaine liquid level gauge, provides an ingenious means for externally registering the level within a tank, without resorting to the use of gauge glasses or pressure pipe lines. In essentials, the liquid level is primarily ascertained by a robust float gear situated within the tank and either constantly or else intermittently under operation by the liquid. The solution of the problem, how to transfer the indication of this float gear through the wall of the tank by a method at once frictionless and

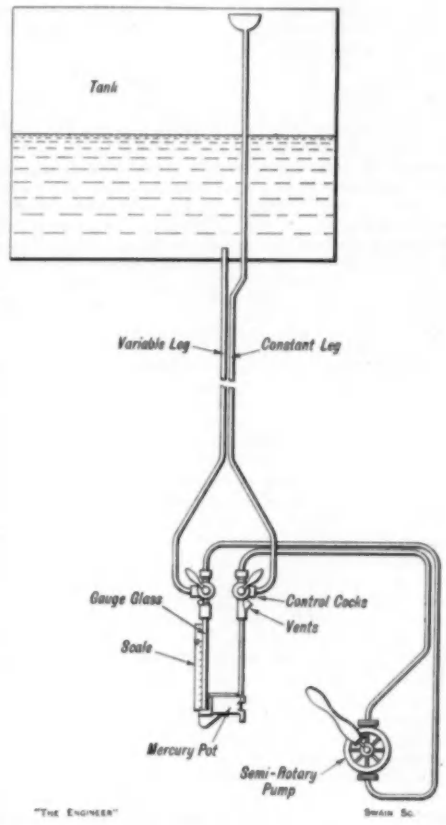


Fig. 131—Pneumercator Hotwell Gauge—Kelvin

pressure retaining, constitutes the feature of the gauge. The float gear is so mounted that its indicating motion is a rocking one about a horizontal axis. This motion is applied directly to one end of a torque tube, which has its other end secured rigidly to the tank wall. This torque tube preferably projects from the tank wall horizontally into the tank, and its inner end, where it is attached to the float gear, is closed. At the end secured to the tank wall the tube is open-mouthed, its connection to the tank being in the form of a flanged annulus, and the tank wall is pierced to admit external entry to the inside of the torque tube. Thus, when mounted, this tube constitutes nothing more than a deep tubular recess in the tank wall, open from the outside and torsionally elastic, being of sufficient thickness of material for pressure considerations and of sufficient length to accommodate fully the required torsional motion of its inmost end without involving considerable stresses. Passing from outside the tank right down the whole inside length of the tube is a suitable stiff rod attached rigidly to the inmost end of the tube. Thus, the indicating motion of the float gear, transmitted to the inmost end of the torque tube, is again transmitted, without interference, by the stiff central rod to any desired point outside the tank. The other details of the gauge comprise multiplying and pointer gear, as suited to the gauging requirements.

The Liverpool Refrigeration Company, Ltd.

Refrigeration machinery was shown by the Liverpool Refrigeration Company, Ltd., of Liverpool, and the objects on the stand were largely compressors, either for ammonia or for CO_2. In Fig. 139 on page 380 we illustrate a direct-coupled steam-driven, high-speed CO_2 compressor. It has two cylinders, 1¾in. by 4in., contained within one cylindrical block.

The crank case cylinders and covers are made from solid steel forgings. There is forced lubrication to all bearings, a separator and filters being incorporated in the oil circulation system. The unit, which is connected to a "Reader" high-speed steam engine through a flexible coupling, is mounted on a large cast iron base, within which are contained the submerged copper condenser coils. It has a capacity of 5 tons standard refrigeration per hour and runs at 600 r.p.m. A compressor of the same type, driven by an electric motor, was also shown.

Two single-cylinder, high-speed, vertical ammonia compressors were of particular interest, since they are fitted with sleeve valves, provided with suction and delivery ports and operated by excentrics on the crank shaft. It is claimed that by the use of this mechanism a high volumetric efficiency is obtained owing to the small gas slip and small re-expansion volume. One of these compressors was driven by a steam engine and the other by an electric motor.

Leo C. Steinle, Ltd.

On the stand of Leo C. Steinle, Ltd., 81, Marsham-street, S.W. 1, an extensive range of automatic machine tools, saws and presses was exhibited. One of the chief sources of interest to the general visitor to the Exhibition was a high-speed hydraulic press for moulding bakelite and other plastic materials. The machine was driven by an electric motor and was completely self-contained. The ram was operated by an oil supply derived from a pump giving a large delivery of low-pressure oil for filling the cylinder quickly and a small delivery of high-pressure oil for the final squeezing. This system of operation avoids the use of accumulators and long pipe lines and enables the approach and return of the ram to be effected quickly by means of the low-pressure supply. An automatic valve is provided for controlling the change from low to high pressure and a hand wheel enables the operator to set the pressure at anything from 300 lb. to 5000 lb. per square inch. In the machine exhibited, which was shown at work on the production of articles in bakelite, the platens were heated electrically, the temperature being under automatic control.

Among the sawing machines on the firm's stand was a "Heller" hydraulically operated cold circular saw with a blade 16in. in diameter and designed for cutting bars, tubes, billets, structural sections, &c. The machine was provided with a hydraulic feed to the saw carriage, hydraulically operated vertical and horizontal vices and a hydraulic system for lifting the stock and moving it forward. The saw carriage could be fed at any speed from zero to 16in. per minute and adjustable stops were provided to disengage the feed at the end of the cut and return the carriage to the starting position. The saw blade was set to cut upwards with the object of transmitting a downward reaction from the carriage to the bed. The hydraulic feed to the carriage was arranged in such a way that the pressure of the saw against the work was at all times automatically adapted to the duty imposed on the saw. For example, at the start of the cut on a round bar the feed per revolution was greater than the feed when the saw reached the largest diameter of the work. The machine could therefore be operated substantially at its full capacity at all stages of the cut.

A second "Heller" sawing machine exhibited on the firm's stand was one designed to cut channels, angles, joists and other rolled sections either square across or at an angle. The saw blade was mounted for downward feeding on to the stock and could be swivelled about its vertical axis through 360 deg. against a graduated scale in order to permit mitres to be cut at any desired angle. No geared speed changes were provided for the saw blade, but four rates of feed were available. A safety clutch was fitted to reduce or disengage the feed motion in the event of overloading, and a quick-power return was provided to withdraw the saw carriage automatically after a prescribed depth of cut had been reached.

J. W. Shillan.

On the stand of J. W. Shillan, of 24, Harrison-street, London, W.C. 1, there was exhibited some representative types of "Climax" high-speed lightweight, heavy-oil engines, which are of continental origin, and are of special interest on account of their working on the two-stroke cycle. The engines are built in sizes of 6, 10, 16, 22 and 32 B.H.P., with one to six cylinders. Fig. 132 shows a section through an engine, which has a bore of 90 mm. and a stroke of 130 mm., and runs at 1000 r.p.m. As will be seen from the drawing, the crank case is cast in one piece with the cylinder, the separate cylinder heads and the single cover forming separate castings. When the cover is lifted, the cooling water spaces are accessible for purposes of cleaning and the cylinder covers can be detached. Forced lubrication is fitted to the main bearings and running parts, and cooling can be arranged by pump feed or the thermo-syphonic system. As the section indicates, the air for combustion is taken in through plate valves in the crank case, and, after compression within the crank case, it passes upwards to the ports in the cylinder liner. The engine operates on the airless-injection principle, the governor being arranged on the end of the crank shaft remote from the fly-wheel and the fuel pump mounted directly above it. Hand speed regulation is provided covering a wide range of revolutions. The atomiser is centrally disposed, and alongside it is the compression release handle. For emergency starting in cold weather a fitting for a starting cartridge is provided, but, normally, the engine starts by hand, or, in the case of the larger sizes, it can be furnished with an air or electric starter. The fuel consumption

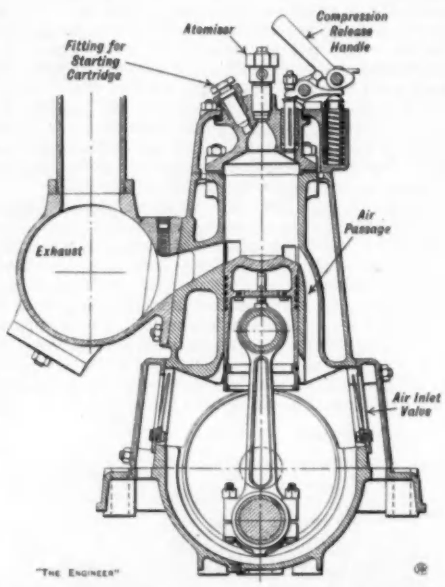


Fig. 132—"Climax" Oil Engine—Shillan

is 0·47 lb. of oil per B.H.P. hour. The engines can also be supplied fitted with reversing gear and propeller.

The Electric Submerged Log Company.

As in many previous exhibitions, the Electric Submerged Log Company, of Port of London Building, London, showed three types of Chernikeeff logs. A very full description of this device will be found in our issue of September 13th, 1929, from which the method of working and details can be learnt. It will be remembered that the instrument consists of a propeller-like rotor driven by the movement of the ship through the water. This rotor drives, through worm and wheel gearing, a make-and-break electrical device. Instruments capable of counting the number of electrical contacts and reading directly into knots can be fitted in any suitable parts of the ship and connected electrically with the log. Arrangements are made for withdrawing the log into the ship for cleaning or when the vessel is passing through shallow water.

An instrument was shown on the stand for adjusting the rake of the blades of the propeller. It consists of two levers, one of which is fastened over a blade of the propeller, the other being attached to the boss. At the further end there is a scale and a pointer arranged so that when hand pressure is applied to bend the vane of the propeller the angle through which it has been turned can be read off. The other blades may then be adjusted to the same degree.

Other Exhibitors.

A large number of other firms made interesting exhibits at the Exhibition. Many of these were of a kind hardly amenable to a long description, while, owing to lack of space in our columns, it has been found impossible to describe the exhibits of others as fully as they deserved.

The Parsons Marine Steam Turbine Company, Ltd., of Wallsend-on-Tyne, showed a set of models to demonstrate the range of its manufactures. A model of the "Turbinia," the famous turbine-driven ship constructed by the late Sir Charles Parsons, occupied a prominent position on the stand, with, beside it, one of the wooden models used for experimental purposes for its design.

Among other firms concerned with steam engineering, E. Green and Son, Ltd., of Wakefield, exhibited types of Green's and Foster economisers, Boltons Superheater and Pipeworks, Ltd., of Stockport, showed superheaters and steam purifiers and separators, while a boiler circulator similar to that described in our issue of November 21st, 1930, was to be seen on the stand taken by Owens Boiler Circulator, Ltd., of 57, Victoria-street, London.

Makers of valves were represented by Victory Valves, Ltd., of Stockport, who exhibited valves of the type we described in our issue of May 22nd this year, and Alex. Turnbull and Co., Ltd., of Glasgow, who showed the Turnbull-Karnath valve, safety valves and pressure-regulating valves, which aroused considerable interest.

The Clews Petersen Piston Ring and Engineering Company, Ltd., of West Heath Works, Hampstead, exhibited Clupet double-coil, no-gap piston rings, and the British Piston Ring Company, Ltd., of Coventry, besides rings, had centrifugal castings on its stand.

Thos. Firth and John Brown, Ltd., of Sheffield, showed Staybrite stainless steel for various purposes, and in a number of applications, and the Sheepbridge Stokes Centrifugal Castings Company, Ltd., of Chesterfield, exhibited centrifugal castings, nitralloy cast iron, and parts hardened by the nitriding process.

In the machine tool section, Sidney G. Jones, Ltd., of 1–3, Brixton-road, London, exhibited "Mikron" gear hobbing machines, and a variety of lathes and milling, grinding and drilling machines made by continental manufacturers, and Grimston, Pritchard and Plutte, Ltd., of 324, Gray's Inn-road, London, had a varied display of portable electric drills, filing machines, grinders, and wire-straightening and cutting machines. Small tools, household fixtures and the like were shown by Atalanta, Ltd., of 1–3, Brixton-road, London.

The Universal System of Machine Moulding and Machinery Company, Ltd., of 13–15, Wilson-street, London, confined itself again this year to exhibiting lifting tackle of a type which we have previously described, and the Transporting Machinery and Engineering Company, Ltd., of 76, Victoria-street, London, showed mechanical handling and labour-saving equipment, conveyors and ropeways. The Carron Company, of Falkirk, displayed cooking apparatus; James Walker and Co., Ltd., of Woking, showed their "Lion" packing and "Walkerite" jointing, and Bakelite, Ltd., of 68, Victoria-street, exhibited various fittings and furniture in bakelite and a new bakelite marine varnish. The Yorkshire Copper Works, Ltd., of Leeds, had a display of condenser and other tubes manufactured in various alloys.

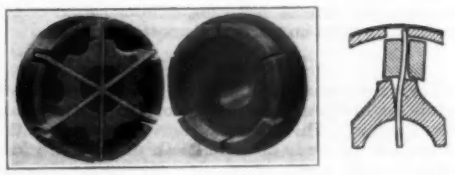
The Atlantic Engine Company, Ltd., of Wishaw, exhibited a high-speed oil engine of 70 B.H.P., and petrol-paraffin engines similar to those described on previous occasions in this journal, and John I. Thornycroft, of Smith-square, London, showed a range of internal combustion marine engines suitable for ships' tenders, pinnaces, motor lifeboats, &c., and models of warcraft, as built for the British and various foreign navies.

Ross Courtney and Co., Ltd., of Upper Holloway, London, had a showcase exhibiting various turned and pressed metal parts. Aeroto, Ltd., of Bush House, London, arranged a comprehensive exhibit of "Aeroto" high-efficiency streamlined screw type fan installations to illustrate its many applications. Among the many oil engines shown, those constructed by H. Widdop and Co., Ltd., of Keighley, were particularly interesting. C. G. Vokes, Ltd., of Lower Richmond-road, Putney, displayed "Protectometer" air intake filters, oil filters, air cleaners and paint-spraying point filters.

Diskon Gear, Ltd., of 64, Victoria-street, London, exhibited a new type of variable speed gear adapted for a number of applications. This gear was fully described in our issue of September 4th last.

A New Flexible Coupling.

A new type of patented flexible coupling of a simple type designed for shafts with diameters of 15 mm. up to 600 mm., or from about ⅝in. up to 23⅝in., has been put on the market by the Axien Babba-Kupplung Kommondit Gesellschaft, of Altona-Ottensen, Germany, and was recently described in the *V.D.I. Journal*. As our illustration shows, the power is transmitted by a series of flat springs which are arranged radially and are supported in a bent seating in such a manner that the outer rim of the coupling is free to move. When the coupling is loaded to its rated power the springs rest on their seatings, and the loading on them remains constant. As a direct result of the shorter lever arm which their seating brings about the resistance to bending is rapidly increased. In the case of an overload, the outer edges of the springs are forced against the sides of the slots in the outer rim of the



coupling, as indicated in the drawing reproduced to the right of our illustration. The manner of loading in the overload position is claimed to be such that even with heavy overloads it is nearly impossible to break the springs, because when stressed they are in double shear.

This particular design of coupling is held by its makers to be of particular value for cases in which it is very difficult to determine beforehand the exact value of the stresses which the coupling will have to withstand. In the "Babba" coupling the parts are so contrived that the shortening of the lever arm of the loaded springs automatically alters the natural period of vibration of the coupling in such a manner that vibrations tend to damp out. The radial arrangement of the springs and the large angle of elasticity, namely, 4 deg. to 5 deg., gives in the stressed condition axial, radial, and angular play. As the interior of the coupling is completely filled with grease, adequate lubrication of the parts is effected and an outer covering prevents any escape of the lubricant.

When it is desired to dismantle the coupling the radial springs are simply taken out, which enables the two halves of the coupling to be drawn apart.

Railway and Road Matters.

As an improvement of the London Electric Railways Company's station was part of the scheme, it may be noted in this column that the Minister of Transport stated on September 30th that the proposed improvements at the Elephant and Castle, to cost £2,000,000, were not an instance to receive a Government grant.

The vacancy in the position of assistant locomotive running superintendent of the North-Eastern Area of the London and North-Eastern Railway, caused by the promotion of Mr. C. M. Stedman to succeed his former chief, Mr. J. H. Smeddle, has been filled by the appointment of Mr. J. J. Lovatt, the York locomotive shed foreman.

The Bill for the extension of the Baker-street and Waterloo Railway from Elephant and Castle to Camberwell Green passed the Committee stage in the House of Commons on September 30th. It will be remembered that in its passage through the House of Lords it was discovered that the site proposed for the new terminus was on the Green, and a new position had to be found for it.

In 1925 containers could be numbered in tens; in 1928 there were 350; now the total number owned by the British railways is over 6000 of varying types constructed to accommodate the numerous classes of freight. The International Union of Railways is holding a competition in Venice to ascertain the most suitable type of container for international use. Two types of British containers are among the last eight, and the jury will be composed of transport officers from various countries, including Great Britain.

Reports of the serious position of the railways in the Irish Free State continue to be received. This is due to road competition, the remedy for which is said to be a Road Traffic Act to co-ordinate rail and road transport. That has been talked of for some months, but, as *The Times* correspondent said lately, business people are complaining, and it is recognised generally that the existing conditions of affairs cannot be maintained. No attempt has been made to restrict road competition against the railways, and the entire transport system is in a state of chaos.

In reply to a question addressed to him on September 30th, the Minister of Transport reported favourably on the street traffic signals in Oxford-street. During the more congested afternoon hours, the increase in average speed was no less than 90 per cent., and the saving of time on each journey nearly 8 minutes. Mr. Pybus added that he had now asked the London Traffic Advisory Committee to consider and report upon the representations which have been received with regard to the regulations. It is proposed to recommend other areas to look into the matter and to decide whether or not they should adopt the system.

We have more than once pointed out that the American Transportation Act, 1920, differed from our own Railways Act of 1921 in that the amalgamations of railways were permissive in the former and compulsory in the latter. As a result, but little has been done as to grouping in America. It is now, however, announced, that, subject to the approval of the Interstate Commerce Commission, the whole of the railway lines operating in the great industrial region of the United States—the country lying east of the Mississippi, north of the Ohio River and west of New York—are to be absorbed by and divided among the Pennsylvania, New York Central, Baltimore and Ohio, and the Chesapeake and Ohio companies. Twelve railway companies, with a total mileage of 37,897 miles and property valued at 8000 million dollars (£1,600,000,000 nominal) are involved in the mergers.

Following up the paragraph as to Scottish railway centenaries which appeared in this column on October 2nd, we would say that the railway opened 100 years ago in Edinburgh was the Edinburgh and Dalkeith. It was sanctioned in 1826 by 7 Geo. IV., c. 98, and began at St. Leonards, now a goods station, on the south-west side of Arthur's Seat. It ran to Dalhousie Mains—now South Esk—with a short branch to Dalkeith, and was opened in July, 1831. At Niddrie Junction a line led off to Walton Walls, and the harbour at Fisherrow on the Forth, whilst another line led off from the same point at right angles to the line from St. Leonards in a north-westerly direction to Leith. The former of these additions was opened in October, 1831, and the Leith line in July, 1838. The lines were designed by Robert Stevenson, the father of Robert Louis Stevenson, and their purpose was to convey coal from the Lothian fields to Edinburgh. Passengers were later also carried, under powers obtained in 1834. Horse-power was the means employed for traction, except that for a length on a gradient of 1 in 30 falling eastwards, soon after leaving St. Leonards, there was a stationary engine. In 1845 the railway was acquired by the North British.

In our Annual Article "Railways in 1930," which appeared in The Engineer of January 16th last, it was stated that as a result of the Development (Loan Guarantees and Grants) Act, 1929, three widenings of the main line work of York were to be carried out on the North-Eastern Railway. These were—(1) from Skelton Bridge, 3 miles from York, to Beningbrough; (2) Alne to Pilmoor; (3) Otterington to Northallerton. On all three lengths there are now only two lines of way. For schemes (1) and (3) there are to be two additional running lines, whilst for (2) there is to be one additional. These widenings will equip the whole of the area between York and Northallerton with four lines of way, except where there will be only three from Alne to Pilmoor, and the existing two from Pilmoor to Green Lanes, immediately south of Thirsk. The just-mentioned length of third line will provide almost the equivalent of an additional two lines, as it is to be signalled for what is known as reversible working, i.e., for both up and down train movements. The contract for the signalling of the length of 30 miles between Skelton Bridge and Northallerton has just been awarded to the British Power Railway Signal Company, and, for the area to be covered, is the largest signalling contract awarded by a British railway company for some years. Among the items required will be 200 "searchlight" colour-light signals, an all-electric locking frame of 115 levers, 456 mechanical levers, 82 all-electric point machines, 15 illuminated signal-cabin diagrams, and 352 track circuits.

Notes and Memoranda.

It is probable that an industry will be started shortly near Niagara, on the Canadian side, for the manufacture of slag wool by the melting of the local limestone rock and subjecting it to a blast of high-pressure air or steam. The material is an excellent heat insulator.

The construction of a large power station for the working of the tin mines on the Malacca peninsula by a group of Swedish engineers who took charge of the work has now been completed. At present, however, the general economic depression has seriously affected the Malay States, and only a third of the 20,000-kW resources of the new station can be utilised, on account of the slackness of trade.

The Ontario Hydro-Electric Power Commission proposes to build during the present year over 1850 miles of primary transmission lines, in addition to the 7100 miles already constructed. It is estimated that these additional lines will serve over 9700 rural consumers and that 3700 consumers will be added to existing lines. During the month ending July 31st, 1931, 273 applications for rural service were received, which will necessitate the building of 90 miles of line.

According to Mr. H. R. Puri, of the Indian Meteorological Department, the height of a rain gauge above the ground level has a considerable effect on its readings. Thus: "Taking the elevation of 1ft. as giving cent. per cent. of the rainfall, a 5ft. elevation may give 96 per cent. and a 20ft. only 90 per cent. Some experiments gave, taking 1ft. elevation at cent. per cent., 102 per cent. at the level of the ground, 101 at 6in., 99 at 2ft., 98 at 3ft., 95 at 5ft., and so on, till at 25ft. the percentage was only 75.

The construction of the first Soviet printing machine was completed on July 24th in the "Rybinsky Metallist" factory. In spite of the fact that the daily circulation of Soviet newspapers is now ten times as great as the circulation of newspapers in 1912, the mechanical basis of the printing industry in the U.S.S.R. is at present very little above pre-war level. The growing need for printing machines has, up till now, been met entirely by foreign machines. The Supreme Economic Council has now assigned the construction of printing machines to four factories situated in Leningrad, in Rybinsk, in Saratov and in Poltava.

Serious uncertainties in the effective value of low resistances for the measurement of large currents may be caused by variations of current distribution at their terminals, owing to the use of many conductors in parallel which are necessary for large currents or to variations in surface contact or pressure of clamping bolts. Temperature rise is also an important cause of variation. The application of principles for the reduction of these errors has been the basis of the design at the National Physical Laboratory of a resistor of 20 microhms, which has been found satisfactory as a reference standard for the measurement of currents up to 25,000 ampères.

Several supply undertakings now make a practice of presenting to their consumers a small quantity of fuse wire. The Ilford Electricity Department issues a handy card, punched with a hole so that it can be hung conveniently near the fuse board, which holds lengths of 5 ampère and 10 ampère fuse wire. A few brief but clear instructions are printed on the card to guide the uninitiated. The South Metropolitan Electric Tramways and Lighting Company has also followed a similar practice for some time. The cards are shaped like a figure 8, so that they slip very easily over any hook or nail, the fuse wire being wound round the middle portion of the card. A separate leaflet is issued giving instructions to consumers in the art of re-wiring a blown fuse. The idea is a very commendable one and, provided the necessity for turning off the main switch first is emphasised in the instructions, there can be no risk of accidents. Where supplies of fuse wire are not available an enterprising but uninformed consumer often resorts to nails, hairpins, iron wire and similar devices to make good a broken circuit.

Some remarks on the painting or staining of wood transmission line poles were made by M. J. Bell, president, Bell Lumber and Pole Company, Minneapolis, Minn., at a meeting of the Association of Municipal Electrical Utilities at Toronto, Ont. According to Mr. Bell, care should be taken in choosing a paint or stain, as the regular linseed oil paint will close the pores of the wood too much and frequently cause early sap rot to start in the untreated portion of the pole. In his opinion, a proper mixture of a base creosote oil with the coal tar colouring out, with the best grade of ground-in oil paste to give the proper colour, is the safest mixture for staining poles. The creosote oil acts as a preservative, and with a small amount of linseed oil in the paste the pores of the wood are not closed as with regular paint. Mr. Bell stated that experiments with this mixture had revealed that it holds the colour well, is cheaper than regular paint, and is much better for the pole. It can be applied with a sprayer or with a regular brush. The painting or staining of poles is sound policy, since in this way many complaints about unsightly poles from cities and individuals are eliminated.

The net tonnage of the vessels that arrived at ports of the United Kingdom during August, 1931, with cargo for discharge at the port of arrival, aggregated 6,855,000 tons, an increase of 64,000 tons, or 0·9 per cent., as compared with the corresponding total for August, 1930. Increases were recorded in the arrivals with cargo from about half the trading areas shown in the published returns, the more conspicuous being "Northern Europe (Foreign)," "Central and Eastern Mediterranean Countries," "West Indies and Central America (Atlantic Coast)" and "South America-Atlantic Coast," but there were substantial decreases in respect of "Australasia" and "North America-Atlantic Coast." With regard to the principal nationalities concerned, the British arrivals with cargo decreased by 104,000 tons, or 2·3 per cent., and the United States arrivals by 62,000 tons, or 16·1 per cent., while the tonnage of German and Dutch vessels increased by 34,000 tons—14·5 per cent.—and 38,000 tons—12·9 per cent.—respectively. The British proportion of the net tonnage of the arrivals with cargo was 64 per cent. in August, 1931, and 66 per cent. in August, 1930.

Miscellanea.

It is proposed to fill in the abandoned old Welland Canal in Canada.

It is reported that the Metur Dam across the Cauvery River in Madras is about 40 per cent. complete and that it will be finished in September, 1934.

It is suggested that the Paris air port may be moved from Le Bourget to Saint-Cyr, and a special road constructed to the capital. The journey by car would occupy about 20 minutes, and the scheme is estimated to cost between 400 and 500 million francs.

The Russian Post Office authorities recently stated that plans are under consideration whereby it will be possible to open up a telephone service between London and Moscow. It is, of course, possible, at the present time, to speak to Moscow from Berlin.

According to statistics prepared by Moody's Investors' Service, during the first six months of this year, Russia bought from America agricultural machinery valued at 37,216,000 dollars, or 74·3 per cent. of America's entire foreign shipments of this class of commodity.

During the first half of this year Canada produced 95,689,288 dollars worth of metals, which represents a decrease of 17·8 per cent. as compared with the corresponding period of last year. The output of coal was 5,891,588 tons, which represents a decrease of 17·7 per cent.

According to the German Machine Union's report, all branches of the German machine industry suffered from bad business in August. Home sales of certain kinds of agricultural machinery and drying apparatus were rather brisker than in the previous month, but this business was up to 50 per cent. smaller than last year. As for export business, only a few firms, for example, pump and pulverising machine manufacturers, received a larger number of orders, the majority of firms recording a decrease. Business was exceedingly small in mining, printing, paper-making, transforming and power-generating machinery.

The London Chamber of Commerce is anxious to obtain information in regard to available factories and factory sites throughout Great Britain. Town Clerks and Development Committees are requested to send full details of these, together with the facilities offered for the establishment of new industries. It is essential that the following points be particularly dealt with:—Gas, water and electricity charges; rail, road, and canal transport; local rates; labour available; rates of wages, approximate; normal hours of employment per day. In the case of ports, details of harbour and dock accommodation is also essential. Particulars should be sent to the Principal, Publicity Department, London Chamber of Commerce, Incorporated, 97, Cannon-street, London, E.C. 4.

An extensive programme of concrete walling and dredging is being carried out on the Grand Union Canal between London and Birmingham. Erosion of the canal banks by the wash of boats has caused trouble in the past, the earth thus worn away collecting as mud at the sides and forcing boats in some places to keep to the middle of the channel. Concrete walling will entail £282,000 being spent during the next few years. Dredgers of a most modern type are excavating the channel to a good depth over all its width. The work involved may be estimated from the fact that last year, before any special deepening scheme began, 105,000 tons of mud and other material were taken out of the canals. Boats loaded down to 3ft. 6in. draught, the maximum of the present long-distance craft, are now able to go through easily from the Thames to Midland industrial centres, and the depth is gradually being increased so that canal carriers can convey still greater cargoes in larger boats without additional cost.

Before very long Bloemfontein will be as brightly lit as any of the main towns in South Africa. Experiments have been conducted gradually and carefully, as street lighting is an expensive item that needs thorough investigation. The latest experiment in St. Andrew-street has proved a great success, and by degrees better lighting will be introduced along the other streets until the lighting of practically the whole city has been reorganised and improved. Apart from the question of brighter streets, the Council realises that good street lighting is one of the most effective controls of crime. Another important matter that is receiving the consideration of the Council is the possibility of a reduction in the price of electric current. In order to assist those people who can only afford to live in the moderately cheap type of house, the Council will probably take into consideration a reduction in the standing charge; this in spite of the fact that electricity charges in Bloemfontein are among the very lowest in South Africa, and reckoned on a *per capita* basis, among the lowest in the world.

Although the depression which rules in Australia has affected the electrical trade seriously in common with all other businesses, every branch has not suffered equally. Important extensions to metropolitan supplies which were contemplated this year are in the discard. According to the *Electrical Times*, sales of domestic appliances and small lighting and heating plants, suitable for country houses, have declined substantially. At the same time it is a curious fact that apparatus designed, more especially for amusement or comfort, is selling extraordinarily well. The radio set sales for the year 1930 made a record, apart from the few years at the beginning of the broadcasting era. In the whole Commonwealth no less than 85,000 radio sets were sold, and there is every indication at the present moment that this figure, if it is not exceeded, will certainly be approached this year. Many manufacturers, making sets which sell at from £20 to £39, are two or three months behind in supplying their orders, and many firms which have concentrated on making electrical parts, or which have been satisfied to make only radio accessories, have entered the set-making and selling field with great zest. One of the most important of them is Standard Telephone and Cables, Ltd., which is manufacturing for several firms, using, very largely, British and Australian-made parts.

SOME EXHIBITS AT THE OLYMPIA EXHIBITION

(*For description see page 371.*)

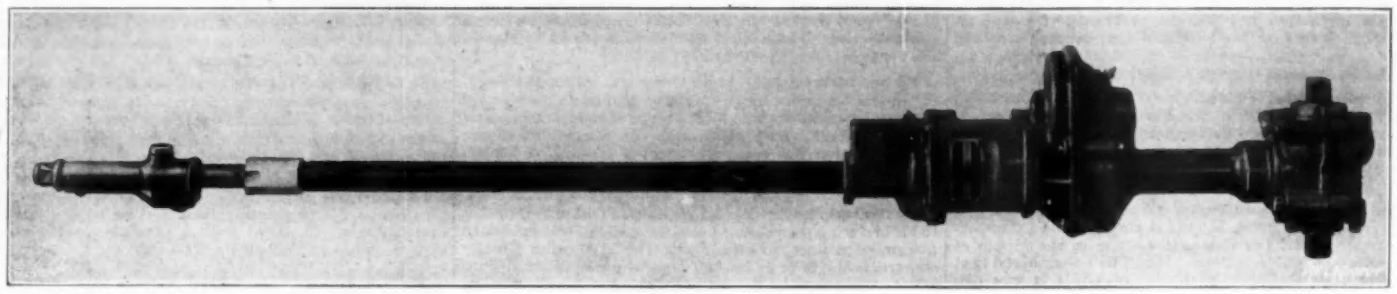


FIG. 133—PNEUMATICALLY-OPERATED NUT WRENCH—CONSOLIDATED PNEUMATIC

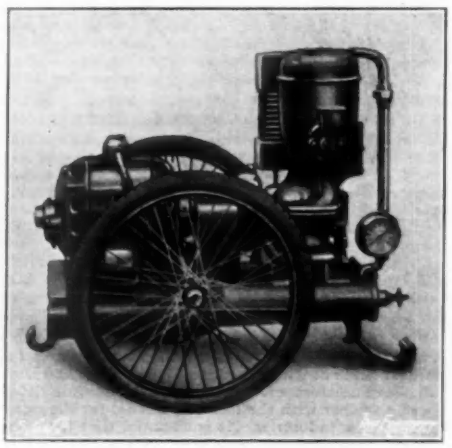


FIG. 134—PORTABLE COMPRESSOR—LACY-HULBERT

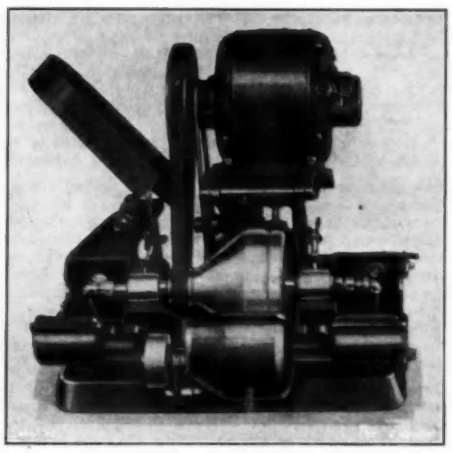


FIG. 135—OIL SEPARATOR—ALFA-LAVAL

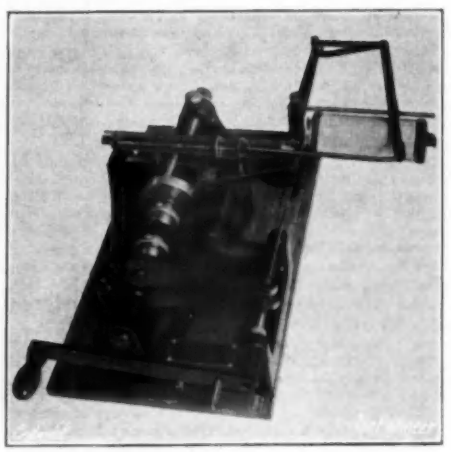


FIG. 136—TESTING MACHINE—TENSOMETER

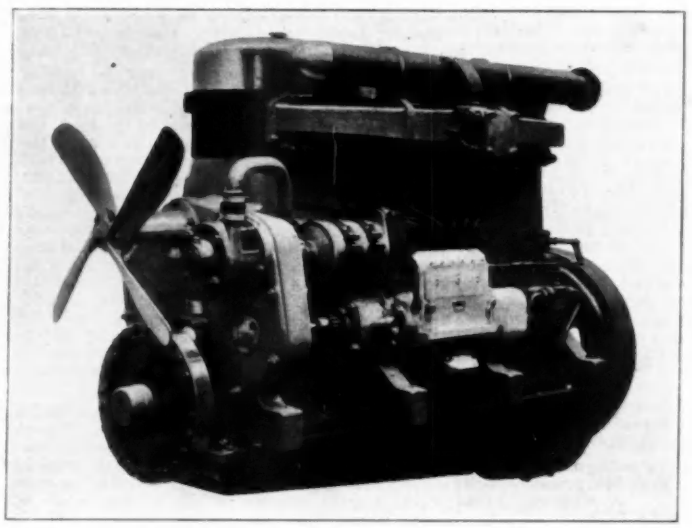


FIG. 137—38 B.H.P. HIGH SPEED HEAVY OIL ENGINE—RUSTON-LISTER

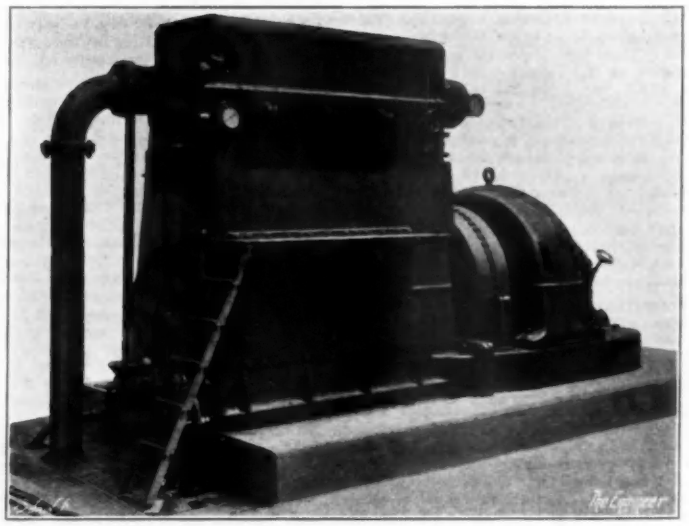


FIG. 138—240 B.H.P. OIL ENGINE AND DYNAMO—TANGYE

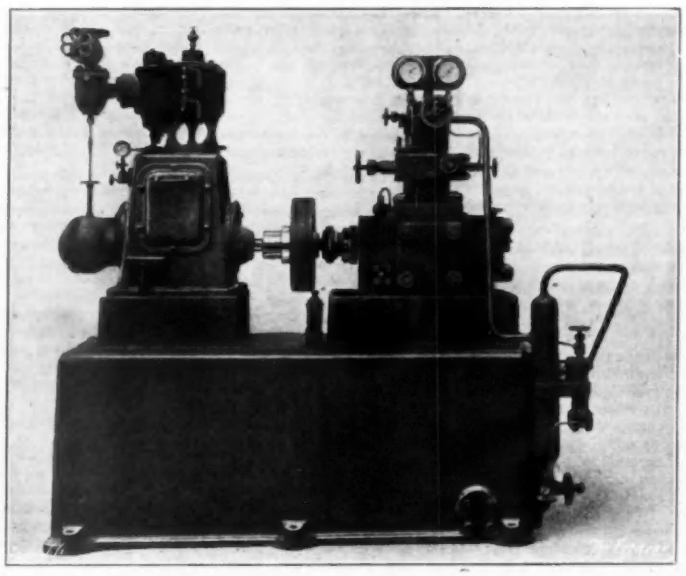


FIG. 139—STEAM-DRIVEN CO_2 COMPRESSOR—LIVERPOOL REFRIGERATION

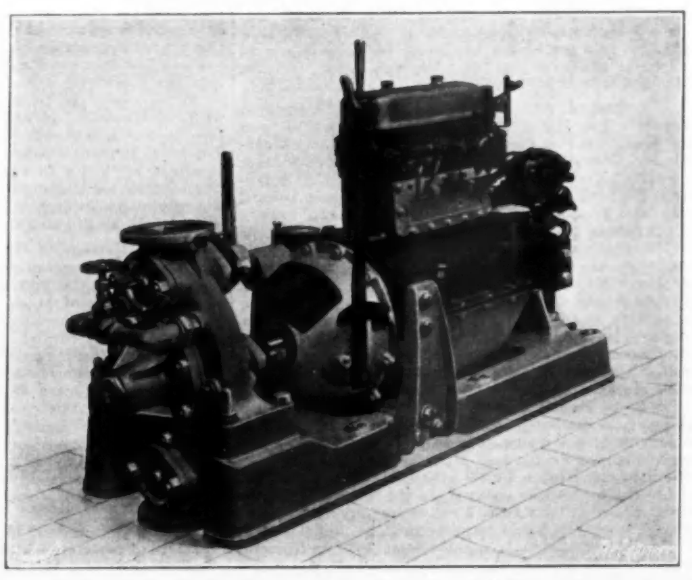


FIG. 140—SELF-CONTAINED OIL PUMPING UNIT—STOTHERT

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THE ENGINEER.

Vol. CLII. No. 3952

OCTOBER 9, 1931.

Engineers and a National Government.

Now that the suspense is at an end and the decision has been made to hold a general election at the end of the present month, it is, perhaps, desirable that we should say one word to our readers, even though we may appear to touch upon a purely political subject. If we may do so, we would suggest that engineers, whether they be employers or employed, clear their minds of all party feeling. Not for many years, possibly at no time, has there been an election so essentially industrial in character. The purpose which all electors must keep in view is the restoration of the financial position of their country. A Government devoted to that purpose asks for the support of the country at the forthcoming election. Mr. MacDonald is the head of that Government, and will remain at its head if the country so wills. We cannot suppose that all our readers will welcome him as Prime Minister ; it may even be that the majority of them, not being "Labour," are opposed to him. Yet we ask them to forget his past policy, to remember that he had the courage to form the recent National Government and to insist on economies in direct opposition to the mass of his party, and, above all, that he will, if returned, lead a Cabinet of which the primary aim will be the restoration of the financial position, and with it the trade and industry of Great Britain. No doubt many of our readers dislike one of the means which must almost inevitably be employed by a National Government to that end. Although tariff reform now receives the support of probably 90 per cent. of those in the engineering and allied industries, there are still many opposed to it. Again, we ask them, in spite of their convictions, to give the National Government their support. We need not remind them that the new Cabinet would contain many out-and-out opponents to tariffs who would only forego their opinion because, in the face of the country's necessity, they saw no alternative. But the very fact that they, with Mr. MacDonald at their head, detest protection, will ensure that nothing is done without the most careful deliberation and only if no doubt remains that the imposition of tariffs will bring about an improvement in trade, or enable us to maintain the balance of the Budget by an increase of revenue.

The whole world is watching Great Britain at this critical juncture. If she makes a mistake and returns once more to power a party which has no idea of economy, but is pledged to extravagance and the overthrow of established things, she will not only fall herself over the precipice which she has barely escaped, but may carry down Europe with her. If, on the other hand, she takes the wise course of retrenchment, if she puts her own house in order, and if she re-establishes her industries and restores confidence by stability of purpose, the whole world will be the better, and we may expect to see at length that revival of trade which has been so often promised and so often deferred.

Non-Destructive Testing.

The appointment of a committee by the Association of American Mining and Metallurgical Engineers to report on "Non-destructive Testing" was an interesting and important event in engineering. The report will be awaited with great interest, not only as a pronouncement concerning comparative methods of test, but also because it is likely to define the true significance of the actual discovery of flaws in engineering structures. Probably in more than one department of science there is a danger that methods and accuracy of diagnosis may be developed at the expense of research in curative procedure. This tendency would lead to unsound practice, because diagnosis has its real value as a factor, albeit an important one, only when it realises an ultimate goal—the successful treatment of the malady. Yet since modern engineering practice demands certain knowledge of the soundness of structures whenever it can be obtained, a valid and absolutely reliable method of inspection is a desideratum profoundly to be sought.

Every development of methods of diagnosis merits the close attention of engineers, particularly if it leads to a persistent search for a radical cure of the defects it reveals. Amongst such development must be placed the examination of metal by radium, to which Dr. Mehl devotes an important article entitled "Non-destructive Testing by Gamma Rays from Radium," in the August number of the *Journal* of the American Society of Naval Engineers. Let us ask then to what extent the method is likely to operate to reduce unduly high factors of safety by ensuring sound material, and how far its use is economical and practicable. In the first place, we will consider the question of castings, which may be divided roughly into two grades, first and second. High-grade castings are always very important, and it may very well be that a 100 per cent. inspection by radiology is justified in spite of the expense referred to by Dr. Mehl. All defects, such as blow-holes, cracks, contraction cavities, segregations, and so on, may be shown by radiological methods with extreme accuracy. By X-rays it is possible and practicable to examine steel up to a thickness of 3½in. and to show defects which occupy about 0·2 or 0·3 per cent. of the total thickness of material examined. Above this thickness the use of X-rays is not practicable, although 5½in. of steel have been penetrated by using an X-ray tube working at 450 kV. The exposure in the latter case was one hour, and, incidentally, to obtain the same result using 78 mgr. of radium bromide an exposure of the order of seventy hours was necessary and the result was not so clearly defined. At the same time, where important castings justify the examination of very great thicknesses of steel, radium would appear to have a very distinct value. Unfortunately, it is very expensive, and in order to use it in a practical manner for the examination of engineering structures, large quantities are required. Its price may be taken as approximately £10 per milligramme, and 100 mgr. of radium salt must be regarded as the minimum amount which will yield useful results. It is true that radium emanation may be employed, but its half life period is under four days, which limits the practical examination of steel to about 5½in. unless very large quantities of the gas

are available. In addition, the production of radium emanation is by no means a simple matter. Its use presupposes the fairly close proximity of a large quantity of radium salt and an adequate pumping system devoted entirely to the work of production. The cost of such facilities, while not being prohibitive, would be a very serious consideration in most cases. Such, then, is a broad comparison between the use of radium and X-rays for the practical examination of first-grade castings. On the whole, X-rays are to be preferred because of the shorter exposures and the increased definition obtainable; but at the same time radium has certain advantages, one of which, as Dr. Mehl points out, being that it is possible to obtain several pictures during one exposure if the specimens lend themselves to suitable arrangement.

Let us now turn to low-grade castings. Clearly a 100 per cent. examination by radiology for flaws is out of the question by reason of its expense. Unquestionably castings are not perfect, flaws are common and, moreover, they are known to exist. How far do they matter and how much better off should we be if all flawed castings were condemned? The flaws are due to faulty casting technique and not to basic ignorance of their existence. Therefore, apart from the expense, a 100 per cent. radiological examination would merely have the effect of condemning structures that hitherto have been used, on the whole successfully, in carefree disregard of their—tacitly—recognised unsoundness. In this class of work it is not radiological *inspection* that is required, but the use of X-rays or radium as a consultative tool in the foundry. Flaws in castings are an evil, and inasmuch as a careful study of the design and conditions of casting is certainly capable of producing better structures, X-rays should be used to reveal the site and nature of typical defects in the product of every new batch in the foundry. The results should be studied on the spot by the designer and the foundry manager and steps taken to effect improvement where necessary before proceeding with production. It is in the foundry that radiology seems to promise help to casting practice in general. Here again it would appear that on the whole X-rays have advantages over radium. The very fact of the smallness and great value of the radium unit renders it unsuitable for ordinary works practice. But X-ray equipments may be designed to be safe and very nearly foolproof in operation. They cannot be lost or mislaid and their maintenance cost is practically negligible. So much for castings. When we turn to forgings, particularly of modern complex constitution, we are faced with a much more difficult problem. How far is the examination of forgings by radiology a practical proposition? This is a question that can only be answered by the persons concerned in their manufacture and use. The small cracks which are sometimes found in modern high-grade forgings of complex steel may, we suppose, be investigated by radiology to determine their extent; but whether the expense of a complete radiological examination is justified depends upon the importance attached to the work and the characteristic dimensions and significance of the typical flaws. Radium would not be of value in such examinations as the fineness of detail desirable in the radiograph would be impossible of realisation.

It has been the policy of THE ENGINEER to encourage, at every opportunity, the development of non-destructive testing, such as radiology, in all its aspects, and it is a matter for gratification that in this country the subject has received particular attention. There is no doubt whatever that the unique property possessed by X-rays and radium of revealing details of the internal structure of materials without injuring them is potentially of the greatest possible value. All that remains is to develop the technique of the subject and its interpretation in engineering terms. Further, the method must be capable of use in factory practice by technical men as distinct from research physicists in order that its value may be appreciable as a constructive factor in general engineering progress.

Motor Cars in France.

BEING the first of the Motor Shows, the Salon de l'Automobile, held in Paris this week, has usually a special interest as presenting novelties, and giving an idea of the trend of the industry in the way of designs and improvements. It also offers an indication of the state of the industry itself. The Paris Show is always popular, and there is no decline of public interest in the cars exhibited this year, but that interest does not necessarily imply that there will be an improvement in the outlook for motor car manufacturers. There have been times when the motor trade was worse than it is now, but trade has never been so bad generally. The home market has been fairly good, so far as concerns the increasing number of cars in service, the number in proportion to the population being now greater than it is in Great Britain, but the home demand cannot absorb anything like the total production, which has been developed largely for export, and the foreign trade in cars has declined considerably. The situation of the industry is, therefore, far from satisfactory. Most of the business is done by the three makers of light cars—Citroën, Peugeot, and Rosengart—and for reasons of economy in taxes, running costs, and upkeep, the 10 horse-power car is giving way to the 7 horse, while even the 5 horse vehicles are still popular. Little change can be looked for in these light cars, which are turned out on mass production lines, and the necessity of keeping down the cost precludes the use of accessories or refinements that would add materially to the price, although in one small car an attempt is made to provide silent gears by the use of compressed hide pinions.

French builders of higher-powered touring cars have always been reluctant to make changes, unless they were forced upon them by innovations that have proved successful abroad, and a marked feature this year is the free wheel, which has now been adopted by some American firms, though its application offers such obvious advantages that it was used tentatively years ago by some makers on this side of the Atlantic. Cars so fitted are also shown by some French makers, notably Chenard and Walcker and Mathis, and in view of the many claims made on its behalf, such as reduced load on the engine, economy in fuel consumption, change speed without declutching, and generally less wear of car and tires, it is believed that it will come rapidly into public favour. There are no other notable departures from usual designs at the Paris Show. About the same proportion of six and eight-cylinder engines are to be seen, and the four-cylinder engine continues to hold its own. There is a growing preference for sparking plugs at the tops of the cylinders, with, sometimes, inclined valves to reduce the area of the side chamber, but there is a good deal of latitude in the arrangement of plugs and valves. The engines are always closed in for the sake of neatness. Much has already been done in the way of providing silent gears when running on other than top speed, and any further progress is likely to arise from new methods and devices—one of which is the free wheel, which is said to give an effect of synchronisation. The Armstrong-Siddeley automatic change-speed gear allows of silent running at all speeds. It appears fairly obvious that motor car design has been developed as far as it will go along present lines, and is so simple, compact, and economical, that manufacturers do not always welcome innovations that will necessitate important changes, but the possibility of changing speeds without declutching and of silent running having been demonstrated, it is inevitable that there will be changes in the future. The front wheel drive does not hold a high position in the automobile industry. Yet the number of cars with front drives has increased. They have come this year from America, Czechoslovakia, and Germany, and there are three or four French cars so driven The great advantage of the system is that it leaves the frame quite free for the body. There are also mechanical advantages as well as drawbacks, and if the front wheel driven car continues to make headway, it can only be after long experience. For the moment, it has not got within range of the popularity of the normal type of car. The British industry is represented at the Paris Show by Rolls-Royce, Armstrong-Siddeley, Humber-Hillman, and Austin, and if present events should develop in favour of more equitable exchanges, it may be hoped that British firms will eventually find themselves in a better position for doing business on the Continent.

So long as everyone is looking for improvements in touring cars, and there are isolated evidences that such improvements are possible for the convenience of drivers, it may be supposed that they will be developed by the competition for foreign trade which is becoming keener than ever. The cars now built are wonderful engineering productions, and are entirely satisfactory to users, but the ordinary type of foreign touring car is not remarkable for silence, flexibility and ease of driving. These are qualities that have to be paid for. Nevertheless, they may be provided at a cost that should not prove excessive to the foreign buyer.

Obituary.

EDWARD CARPMAEL.

THE death of Mr. Edward Carpmael is announced as having taken place at his home in West Norwood on Tuesday last, October 6th, after a long illness. Mr. Carpmael, who was in his eighty-fourth year, was the son of William Carpmael, a consulting engineer and patent agent, who for a number of years served prominently on the old Metropolitan Board of Works.

Mr. Edward, though he did not practise as an engineer, had, during his preparation to enter his father's business as patent agent, received an extensive training in engineering matters. In the course of his active professional career, which lasted for about half a century, it fell to his lot to draft the specifications for letters patent in connection with many of the leading inventions of the time, among which may be cited the original Marconi specification in 1896.

He was a founder member of the Institute of Chartered Patent Agents, which was formed in 1882, and to the Council of which he was nominated in 1888. He served as President during the period 1899–1901. In 1921, after he had retired from practice, he was elected an Honorary Member of the body, being the fourth to receive that distinction, the three first having been Lords Alverstone, Moulton, and Parker—all of them judges of the High Court.

Mr. Carpmael, who had been a Scholar at St. John's College, Cambridge, took a mathematical degree among the Wranglers of his year. He was an Associate of the Institution of Civil Engineers and a Fellow of the Royal Astronomical Society.

THOMAS LAKE AVELING.

MR. THOMAS LAKE AVELING, of Pettings Court, Wrotham, Kent, after speaking at a meeting of the local Nursing Association on October 5th, collapsed and died immediately.

He was born at Ruckinge, Kent, seventy-five years ago, and after leaving school spent a number of years in the works of Aveling and Porter, at Rochester, gaining a full knowledge of the business.

In 1881, when still in his early thirties, he succeeded his father as head of the firm, and on the formation of the company in 1905 became managing director, continuing in that capacity until his retirement from business in 1928. He was one of the original directors of Agricultural and General Engineers, Ltd., a company with which Aveling and Porter is associated. For many years he was on the Council of the Smithfield Club, of which he became President in 1929, and was also for many years on the Council of the Royal Agricultural Society of England. Locally he took a prominent part in public affairs, and for many years was Chairman of the Medway Conservancy Board and a Warden of Rochester Bridge. He was a member of the Institution of Civil Engineers and of the Institution of Mechanical Engineers.

RECLAIMING THE ZUIDER ZEE.

IN our issues of August 9th and 16th of 1929 we gave an illustrated description of the measures which are being taken to reclaim the Zuider Zee. A year ago the first north-west polder was pumped dry and its drainage was started. Subsequently the Dutch Government decided to suspend operations on those parts of the scheme which had not yet been begun. A full statement of the position is now given in the recent Budget for 1932 for the Zuider Zee Fund, which contains the information promised by Dr. Reymer, the Minister of Public Works, at the time of the suspension of the new work. It is stated that the construction of the large dam, which will close off the Zuider Zee, and that for the drainage of the north-west polder will be completed at the end of 1932. The estimated cost of the large dam will be, it is expected, about £14,000,000, while that of the north-western polder will be about £8,300,000. It is pointed out that both these sums are higher than the probable value of the reclaimed land. In view of the present financial position of the country, and the general uncertainty with regard to the development of Dutch agriculture in the near future, the Government considers it desirable to suspend work on the reclamation of the south-east and south-west polders, but it proposes that investigations into the scheme for the reclamation of the north-east polder shall be continued.

OFFICE buildings have become so extensive in the United States that they are now being equipped with permanent installations for helping in the washing of the windows. These "helps" take the form, as in that of the building of the A. O. Smith Corporation, Milwaukee, of a trackway on the roof equipped with a transporter for carrying a cage from which the window cleaners work. It would seem that there is an opening for some inventor who could devise a self-cleaning glass, something after the fashion of titanium white pain or the exfoliating copper bottoms of our old sailing ships.

The Faraday Exhibition.

No. III. (*conclusion*).*

Perhaps the most attractive exhibit in the transport section of the Exhibition was an example of the tunnel telephone system as used on the underground railways. Two uninsulated wires are run throughout the whole of the tube tunnels with connections into each sub-station. Each driver carries a portable hand telephone set, with clips for attaching to the wires. If, in the case of emergency, it is necessary to have the track current switched off, the driver clips his hand set on to the wires, or, in the absence of the hand set, pinches the wires together. This automatically opens the circuit breakers feeding the traction current to the section concerned, and gives audible and visual signals at the sub-stations at each end of the section. Provided the motorman's hand set is attached to the wires, the sub-station attendant is able to converse with the motorman and ascertain the reason for the cutting off of the current. After the traction current has been switched on, the whole of the automatic apparatus can be reset by the pressing of a button at the sub-station.

The Electric Lamp Manufacturers Association's exhibits showed the principal stages in the manufacture of electric lamps, but the machines in use did not correspond with those employed in the most up-to-date lamp factories, because the most modern machines are so screened from view that they are unsuitable for demonstration purposes. During certain hours of the day visitors had an opportunity of seeing lamps pass through the various processes of manufacture, including coiling, inspection, "pinch" making, the insertion of the supporting wires, the mounting of the filament, the sealing in, exhausting, capping, ageing, and testing. Among the complete lamps exhibited were two of the largest in existence, each lamp being rated at 10 kilowatts, and intended for aerodrome or beacon lighting. At the other extremity of the range, which included lamps for every conceivable purpose, there were "grain of wheat" medical lamps.

No branch of the electrical industry was better represented than that of electric industrial heating. For the arrangement of the exhibits as well as those relating to the use of electricity in the home, the British Electrical Development Association was responsible, and the demonstrations and exhibits showed electricity applied to industrial heating in the various well-known ways. Most of the apparatus, however, was too familiar to engineers to need description, and it will suffice to consider the Bastian electric boiler shown in Fig. 17, in which current is passed

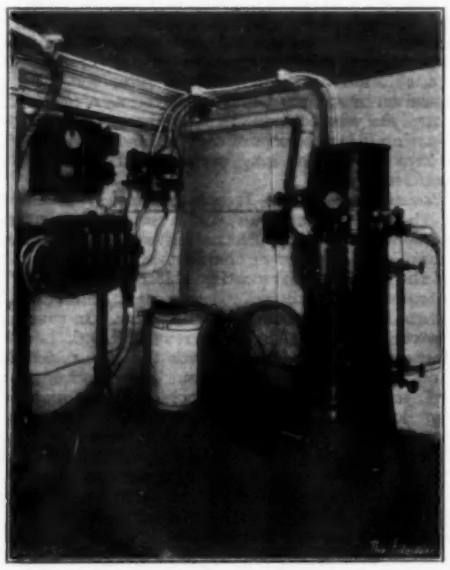


Fig. 17—Electrode Boiler

through the water from heavy cast iron electrodes. The automatic control is arranged to keep the current, and, therefore, the steam output, within 5 per cent. of that for which the boiler controls are set, and to control the current so that if the demand for steam is reduced, the current is also diminished. This is done by two valves, A and B, Fig. 18, one being operated by the current the boiler is taking, and the other by the steam pressure in the boiler. When the current exceeds that for which the boiler is set, the current in the transformer D becomes sufficient to operate the relay on the control panel E, which, in turn, opens the electro-magnetic valve B through a 60-volt potential transformer F. A small quantity of water is then blown down from the boiler through the valve B and returned by the pipe G to the feed tank H. The water level then falls, the current is decreased, the relay ceases to operate, and valve B closes until the current again increases. The change in conductivity of the water as it heats up is thus immaterial. When the pressure exceeds that at which steam is required, which may happen if the steam demand is reduced and the current control left unaltered, the valve A lifts and again a small amount of water returns to tank H from the boiler, which will continue to blow down until the pressure falls and the steam demand is in equilibrium. If no steam is required, the boiler will blow down completely and the flow of current will cease. The control is said to be so effective that, although the boilers are fitted with ordinary safety valves, in practice they seldom, if ever, operate. To start the boiler all that is necessary is to start the pump. Water then feeds into the boiler and the current rises slowly until it reaches the value for which the boiler is adjusted, when the controls operate. When the equipment is arranged for automatic starting, a thermostat, pressure switch, or time clock starts the pump. Steam is raised at once, and the full output can be obtained in a few minutes.

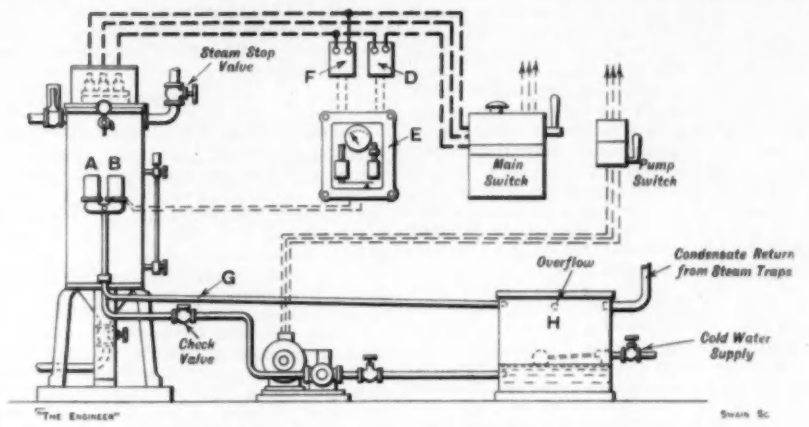


Fig. 18—Control System for Electrode Boiler

The Cable Makers' Association's exhibits were designed to give a general impression of the modern methods adopted in the transmission and distribution of electricity. The back of the stand was occupied by a large model showing the electrical distribution in a small town or village, the electricity for which was represented as supplied through the "grid," from the model of the generating station on the adjoining stand where there was a "grid" transforming station for lowering the pressure from 132,000 volts, and from that station secondary high-tension overhead lines were shown terminating in a small outdoor sub-station, where the pressure was supposed to be further reduced for local distribution to a portion of the village. This local distribution was shown as carried out by means of low-tension lead-covered paper insulated cables laid underground, and from those cables other cables were led off for supplying model buildings.

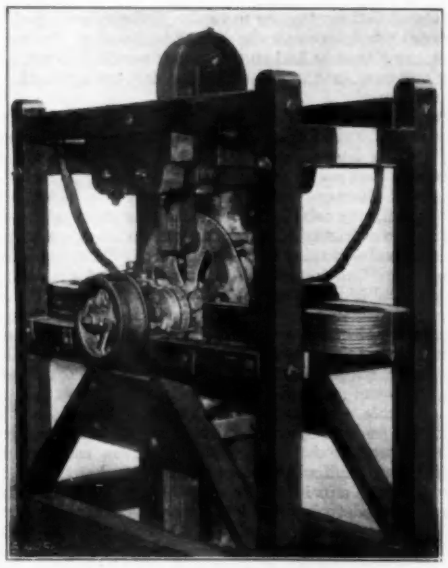


Fig. 19—Woolrich's Generator, 1844

In addition to this general model showing the steps by which electricity reaches the consumer, there were actual samples of modern overhead and underground wire and cable systems and accessories.

Reverting once more to the historical side of the Exhibition, the first industrial generator used for electro-plating, and mentioned in our issue of September 25th, is shown in Fig. 19. It was built by Woolrich, of Birmingham, in 1844, and it belongs to the Museum and Art Gallery of the Corporation of Birmingham. Its armature, which revolves between the poles of permanent magnets, consists of a number of bobbins wound with insulated wire and mounted between two discs on the shaft. As the machine was designed for electro-plating, it, naturally, has a commutator, and the brushes are composed of solid strips of metal. Its output was about 25 ampères. Other early machines exhibited by the B.E.A.M.A., apart from those referred to in our issue of September 25th, were the Holmes' and Gramme's electro-magnetic machines of 1867 and 1870 respectively; Wheatstone's original dynamo of 1867; Wilde's multipolar dynamo of 1867; the Brush dynamo—Fig. 20—of 1878, and the Edison-Hopkinson machine developed during the years 1883-86.

The Brush dynamo, shown in Fig. 20, did quite good service in bygone days. It is of the "open coil" type, and was extensively used for supplying a number of arc lamps joined in series. Machines were made for developing high-tension continuous currents at voltages up to 3000. The armature consists of a cast iron ring, grooved to reduce heating, and provided with eight or more recesses to receive the coils which are wound in them round the iron core. The inner ends of every two diametrically opposite coils are joined, while the outer ends are brought back into the shaft and through an axial hole to the commutator, which is carried on an insulated sleeve. There are two sets of collecting brushes and the commutator is double, every pair of coils having separate segments on each. When running the commutation is such that of the eight coils on the armature, one

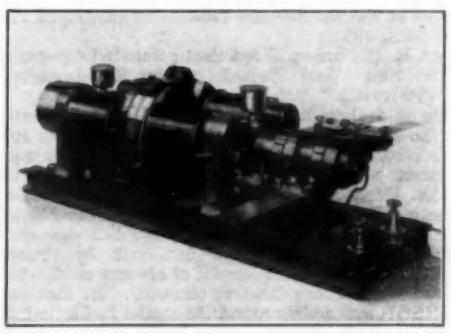


Fig. 20—Brush Dynamo, 1878

pair of opposite coils is in series, two pairs in parallel, and the remaining pair then passing the inactive portion of the field is cut out, thus differing considerably in action from the ordinary closed closed-coil type. The field magnets are in series and have extended cast iron pole pieces, there being four poles and four magnet coils. A special form of regulator was employed to keep the current constant when the resistance of the circuit was altered. In the larger machines the cast iron armature was replaced by a laminated one formed of thin iron plates and ribbon—an improvement that increased the output 50 per cent.

The chemical and electro-chemical sections of the Exhibition were of great interest. Here, again, many demonstrations were being made, including that of the production of liquid air by the British Oxygen Company, which was showing a Hampson air liquefier.

The first laboratory experiments in the culture of seeds by means of high-frequency current have begun in the Institute of Plant Growing of the Lenin Academy of Agricultural Science. The seeds of wheat, flax, oats, carrots, and peas were subjected to the influence of the electric current. Within the first few days an acceleration in growth of the wheat seeds was noticed. The work is being carried out by a group of scientific workers in the physiological laboratory under the direction of Professor N. A. Maximov, and with the collaboration of A. N. Gaman, the constructor of the high-frequency apparatus, and a group of research students.

* No. II. appeared October 2nd.

The British Association Centenary Meeting.

No. III.*

SECTION G. (*continued*).

WIND TUNNELS.

In the morning of Friday, September 25th, the third paper to be considered was one on "The Compressed Air Wind Tunnel of the National Physical Laboratory," by Mr. Ernest Relf.

In the early part of this contribution credit was given to Mr. McKinnon Wood, of the Royal Aircraft Establishment, for the design in 1921 of a compressed air tunnel which, though discussed by the Aeronautical Research Committee, was not adopted, because it was thought the time was not opportune to embark upon such a scheme. When in the next year such a tunnel was erected in America, and tests were made with it on models submitted by the British authorities, it was recognised that the claims made for the compressed air tunnel had been substantiated, and the necessity for such a type of equipment in Britain was acknowledged. It was found by experiment that aerodynamic forces only varied approximately as the square of the speed. The departure from the rigidity of the square law was commonly referred to as a scale effect. That unfortunately was often of considerable importance. What was, therefore, sought was some form of laboratory equipment which would give full-scale information. The law of dynamic similarity gave an expression for the force acting upon the aeroplane, as dependent upon the square of the speed of motion, modified by a function representing the speed of motion multiplied by the size of the aeroplane, and divided by the kinematic viscosity of the fluid. This modifying function, though not large, was of great practical importance, when dealing with such matters as the maximum lift of wings and the drag of bodies of good streamline shape. It was therefore desirable to have a tunnel in which to conduct tests with models at the same value of what had been referred to above as the modifying function, as was found in actual flight. For that purpose, the use of compressed gas afforded the only possible solution. When air was compressed to, say, 20 atmospheres, the value of the kinematic viscosity was reduced twenty-fold, and tests of a one-tenth scale model could be made at half flight speed. Since the density of the fluid had been increased by twenty times, the forces on the model, though much greater than in an ordinary wind tunnel, were not so great as to present insuperable difficulties in the support of the model, without undue interference with the flow.

The author then described the high-pressure wind tunnel at the N.P.L.—see THE ENGINEER, April 17th and 24th, 1931.

Mr. R. McKinnon Wood then presented a paper on "The New Wind Tunnels of the Royal Aircraft Establishment."

He said that in the three wind tunnels erected at the Royal Aircraft Establishment between 1915 and 1919, tubes of square cross section were used, through which air was drawn by a fan at the outlet. Models were therefore tested in an enclosed stream. Recently the smallest of these tunnels had been removed and replaced by a 5ft. diameter open-jet tunnel, modelled upon that built by Prandtl and Göttingen. A free stream of air was used, which flowed right across the test chamber. In that case the absence of walls around the model facilitated the work, and the power required was much reduced. The maximum wind speed was 115 miles per hour, but it was intended to raise it to 250 miles per hour.

A large tunnel was to be erected at Farnborough with a wind stream diameter of 24ft., and a speed of 120 miles per hour. Actual aircraft were to be tested in that equiment, a special ventilated system having been installed for the removal of exhaust gases, when the engines of a machine were running. Though it would not be possible to obtain the lift and resistance of the entire plane tested, for parts of its wings would extend beyond the air stream, the effects of variations in the central parts of the construction would be obtainable, and would give information of enormous value to the designer. A free flight test chamber with the air flow in a vertical direction was also under construction. It would be used for the investigation of spin. The model would be mounted on a vertical axis, upon which the air would cause it to rotate and ultimately rise into a free spin. As the up current would annul the descent of the spinning aircraft a spin of indefinite duration was possible of observation.

Sir Henry Fowler, opening the joint discussion on these two papers, said that there were many difficulties to be encountered in experiments with models, and where the work could be done on full-size equipment it was much to be preferred.

Sir Ernest Moir referred to the dangers of carbon monoxide in exhaust gases. He suggested that back suction had caused the entry of such gases into the cockpits of high-speed aeroplanes with results disastrous to the pilots. Therefore closed cockpits should be used, to which supplies of pure air or oxygen could be given. The neglect of provisions to ensure a good atmosphere for pilots might have been the cause of many otherwise unaccountable accidents.

Dr. A. P. Thurston asked Mr. Relf how the pressure distribution was measured in the high-pressure tunnel, and the author of the paper responded immediately by describing the manner in which the manometers were connected up to provide the information.

Mr. McKinnon Wood said he was interested in the suggestion of danger from the entry of carbon monoxide into an aeroplane cockpit. The question was one purely of quantity of ventilation. He thought that the amount of carbon monoxide getting into an open cockpit must be very low compared with the total air passing through, unless the exhaust was very near to the cockpit. There was no danger of the model in the spin-testing equipment hitting the side. When the model got near the side, the wing tilted up because of the proximity of the wall affectng the air flow conditions. That action prevented any actual contact.

SECTION A.

GEOPHYSICAL METHODS OF PROSPECTING.

On Friday, September 25th, Section A (Mathematical and Physical Sciences) discussed geophysical methods of prospecting, with special reference to instruments. The first contributor to this discussion was Professor A. S. Eve, of McGill University, who said he had made a comparative study of three different electrical methods of prospecting for underground conductors, and gave a brief description of the apparatus and methods employed. The three methods described were the self-potential, the Radiore, and the Gish-Rooney methods, as well as Lee's modification of the latter. The self-potential method was employed nearly 100 years ago by Fox, who communicated a paper on his work in Cornwall to the Royal Society. He had found that copper plates applied to the earth and connected by wires to a sensitive galvanometer revealed the presence of copper ores by a natural electric current due to the disintegration of the ore bodies. In the case of the sulphides of iron, copper, and lead, and of magnetite, the surface and rain water, containing carbon dioxide, found its way down into the earth and caused slow oxidation of the ore body, so that it behaved like a battery, the current flowing through the earth towards the upper part of the vein, which was a negative pole. Unfortunately, the copper plates or electrodes employed also oxidised, so that rather erratic effects were produced in the galvanometer. Monsieur Schlumberger, of Paris, however, introduced non-polarisable electrodes, the simplest of which was an unglazed or porous pot, as used in the Daniell cell, containing copper sulphate solution and crystals, into which dipped a copper rod connected to the wires leading to the galvanometer.

In the Radiore method a rather large vertical loop of several turns of insulated wire was set up and a portable generator sent an alternating current of several ampères round the loop, with a frequency of about 500 cycles per second. If there were underground conductors in the neighbourhood of the loop, then, as Faraday had shown, there would be alternating currents, of the same frequencies, set up in those conductors.

The method used by Gish and Rooney, of the U.S. Bureau of Standards, at Washington—which undertook some investigations on the mean resistivity of the soils and rocks at different places on the earth—involved the use of four electrodes in a straight line, at equal intervals apart. The outer pair might be iron stakes driven into the ground, and a current was sent into the ground from a generator. The two inner "pick-up" or potential electrodes were connected to a suitable potentiometer, and the potential difference was determined when a current flowed between the outer electrodes through the earth. In practice, the interval A between the electrodes was gradually increased from a few feet up to several hundred feet, a graph was made showing the interval A on a horizontal scale, and the measured mean resistivity on the upright scale. The interpretation of the resulting curves presented, even in simple cases, some interesting and difficult mathematical problems, and in most cases considerable experience and ingenuity was required to interpret the graphs obtained.

A comparative method was adopted by Lee, of the U.S. Bureau of Mines, who introduced a fifth electrode in the centre of the line of electrodes. Leaving the current to the outer pair unaltered, he measured the potential difference between the centre and each of the near electrodes. On the same section paper two graphs or curves were drawn, and they showed for the same intervals A the mean resistivities of the ground on either side of the observer, who was at the central electrode. It was then possible to determine without calculation on which side the better conducting material lay, and to form some estimate of its depth. By carrying out these observations at successive stations, the presence of markedly good conductors was determined, provided their depth below ground did not exceed a few hundred feet.

Comparative tests of the three methods mentioned were made a few months ago in an area in which a vertical vein of galena, occurring in metamorphosed limestone, had been worked from the surface to a depth of 1400ft., with a profitable output of lead. The problem was to discover the extent of conducting ore bodies in the neighbourhood. A few years ago that region had been explored by a representative of the Radiore Company, who had located and mapped a large number of conductors in that region and had found their "electrical axes" to have depths of from 100ft. to about 300ft. The lines of these numerous conductors did not appear at first sight to conform with the line of the vertical fissure containing the galena, and the results were, in consequence, viewed with some scepticism. Exploration was begun with the self-potential method along the parallel lines, 200ft. apart, which had been cut for the former geophysical survey. It was found that the natural earth currents flowed into points lying precisely on the lines of conductors, as determined by the previous surveys, and that the magnitudes of the currents bore a satisfactory relation to the intensities as found by the electro-magnetic induction method.

The Gish-Rooney method was tried, and showed better conductivity along the strike than at right angles to the vein, but otherwise no useful result was obtained. The Schlumberger electric probe or "single" electrode exploration, so useful in the case of horizontal underground conducting strata, did not render any better assistance.

Finally, the Lee comparative method was used, and, moving along the strike, it was possible to infer the locality of the highest conductivity. Unfortunately, the method could be used only along the strike where it was straight, as at a curve one half of the line of electrodes might diverge from the line of the conductor. Nevertheless, it was possible to fix certain points which appeared to be most promising for trenching or drilling.

Mr. A. B. Broughton Edge discussed some of the results of the work carried out in this country during the past twelve months, under the auspices of the Department of Scientific and Industrial Research, and with the co-operation of the British instrument manufacturers, with a view to producing a series of reliable electrical prospecting instruments and the auxiliary equipment required for their use in the field. The experience gained in Australia during 1928–30 by the Imperial Geophysical Experimental Survey, he said, had been applied to that purpose, particularly with regard to details of design which were essential for work carried out under rigorous field conditions. He discussed some of the instruments already completed.

Spontaneous Polarisation Method.—For the investigation of naturally occurring electrical phenomena, such as arise in the neighbourhood of certain types of sulphide ore body, a portable D.C. potentiometer and non-polarising electrodes had been designed. The potentiometer had two ranges of 0–50 and 0–100 m. volts, was self-standardising, and could be used on a tripod without any special attention to levelling. The non-polarising electrodes with which contact was made with the ground was either of the usual copper-copper sulphate type or else of silver immersed in a chloride or sulphate electrolyte, the salts of potassium or sodium being employed as a rule. The electrolyte was contained in a porous pot, and by preparing it in the form of a jelly the electrode might be kept in use for long periods without requiring attention.

Resistivity Method.—It was commonly held that for the measurement of earth resistivities it was preferable to employ alternating rather than direct current, and in view of the natural earth potentials and the electrode polarisation E.M.F. that had to be contended with when D.C. was used, there would seem to be good grounds for that view. In practice, however, the use of A.C. or reversed D.C. had its disadvantages, one of which was that the resistivity values derived were dependent on the frequency employed, and in some cases upon other factors which were not always appreciated. D.C. measurements were free from such objections, and could be made without difficulty if the potential electrodes employed were of the non-polarising type, and if all extraneous potentials were balanced before the current circuit was closed. The potentiometer described for the spontaneous polarisation method was provided with a special auxiliary circuit for that purpose, and had been found to be fully effective for resistivity survey work.

Ratiometer Method.—Hitherto one of the principal difficulties experienced in surface potential electrical surveys, in which A.C. was used, had been to take proper account of the phase displacements that arose in the neighbourhood of concealed conductive deposits, and which were of prime importance when making a search for the actual position and extent of the latter. In order to overcome that difficulty, a simple form of A.C. bridge or ratiometer had been devised and served a variety of useful purposes. Potential and phase anomalies might be investigated along selected lines of traverse or a complete picture of the surface potential distribution might be obtained over a large area. In the latter case two distinct series of lines were followed over the ground surface, and were known as equipotential (E.P.) and equiquadrature (E.Q.) lines respectively. Those lines might either be traced directly over the ground with the ratiometer or they might be derived from observations made with the same instrument along a closed series of traverses. Since such a survey was so conducted that the potential spacing of the lines in each series was known, it followed that the surface ellipse at any point

* No. II. appeared October 2nd.

was determined by the angle of intersection of the E.P. and E.Q. lines that passed through it, and by the line intervals in its neighbourhood. For most practical purposes it would be possible, after a little experience, to appreciate the potential and phase anomalies and their practical significance by a simple inspection of the linear diagram that was provided by the two series of lines. It was confidently believed, said the author, that that new method of representing the rather complex surface potential conditions that were met in practice would prove more satisfactory to the electrical prospector than any hitherto developed.

A British Magnetic Variometer.

Captain H. Shaw made reference to a new British vertical magnetic variometer, incorporating several new features with a view to increasing robustness, which had been recently designed. Certain minor alterations were still required, and additional tests were needed, but it would appear that a satisfactory British magnetic variometer was within measurable distance. When one remembered that but a few years ago there were no reliable British instruments for any of the geophysical methods of prospecting, it was a matter for satisfaction that good British instruments for all methods were now available.

A Magnetic Gradiometer.

Professor A. O. Rankine (Imperial College of Science and Technology) discussed the possibilities of constructing a useful magnetic gradiometer, and indicated that a beginning had been made in that direction. The chief difficulties in the use of ordinary magnetic variometers for surveying purposes, he said, were due to the diurnal fluctuations of the elements of the earth's magnetic field, as well as to the onset of sudden and unanticipated magnetic storms. Those effects must be allowed for before conclusions could be drawn as to indications due to local deposits of magnetic material, and that elimination was attended by much uncertainty. A properly constructed magnetic torsion balance would be unaffected by the large-scale variations of the earth's normal magnetic field and indicate only the local anomalies which it was desired to find.

Without special precautions, of course, a magnetic gradiometer would be also a gravity gradiometer, because of the masses of its parts. The effect of gravity could be eliminated by proper distribution of mass in the design, but that would usually be unnecessary, for such a high degree of permanent magnetisation was attainable in modern magnets that the magnetic response could be made about fifty times as great as the gravity response.

An objection to the use of a magnetic gradiometer was the time required for observations, and the consequent slowness of the survey. It might nevertheless be used with advantage in suitable cases in combination with the gravity gradiometer without addition to the time required. Even in other cases, since the allowances for "magnetic topography" would usually be negligible, the time occupied would be less than for gravity surveys.

[The whole subject of Geophysics was outlined in a series of articles in The Engineer of July 31st and August 7th, 14th, 21st, and 28th, 1931.]

SECTION G.

When the meetings of Section G were resumed on Monday, September 28th, Sir Alfred Ewing presided, and the first paper considered was one by Brigadier-General C. H. Mitchell on "Engineers' Contributions to Canada's Development," which was introduced by Mr. J. S. Wilson, in the absence of the author.

Canada.

Canada, said the author, being a new country, could only measure its engineering progress by decades. It was but seventy-five years since its expansion began, and not more than fifty or sixty years since the definite movement of population commenced to the prairie regions westward of the Great Lakes and to the Pacific Coast. The development area of the Dominion, now being disclosed as containing the most valuable of natural resources and largely capable of sustaining population, could be regarded as a belt 3500 miles long and from 800 to 1000 miles wide. To-day development was definitely moving northward. The early period of development was the age of road building and of rail and water communications, when steam application was in its infancy, and when most of the manufactured articles of use were imported from the United States or Great Britain. The country then was necessarily agricultural, with such industry as was required to supply domestic wants, and with export trade only in lumber. The first comprehensive national movement of development was the period of the construction of the great transcontinental highway, the Canadian Pacific Railway, which rapidly became the link binding east and west, and creating through Canada a new and shorter Empire route between Britain and the Pacific. It seemed to-day only a matter of history that the first train load of wheat came eastward from the west in the autumn of 1885, and that the first passenger train westward crossed to the Pacific in June, 1886, in 5 days and 19 hours. Although the population had only increased three times in the last fifty years, it was now about 10 millions; the exports to Great Britain, the United States, and other countries had grown in value from thirty to forty times in the same period.

Engineering progress in all conditions was mainly due to initiative, resourcefulness, and independence of thought. In early stages Canada obtained much help and inspiration from Great Britain, but in recent years it had worked out its own problems in its own way, to meet its special conditions. Canadian engineering had become and remained distinctive, with its own national qualities. Outstanding developments had been made in agriculture and grain milling, in paper manufacture, in mining, in transportation, and in water power, with its interconnected manufacturing industries. Agriculture was Canada's premier industry. In recent years its rapid mechanisation had changed its character. Motor tractors, power ploughs, motor-driven harvesters, and combine harvesters, whereby all processes, including threshing, were completed in the field, had rapidly replaced human and animal labour. For grain storage, Canada had elevators which were quite unique, whether they were for small prairie storage or huge terminal equipments capable of holding 7,000,000 bushels.

The second largest industry of Canada was paper manufacture. Early simpler lumbering methods had given place to the modern and complex mechanised methods on a large scale, in which engineering was the foremost factor. Mining was not yet forty years old in Canada. Ontario gold mining dated back only eighteen years, silver twenty-eight years, nickel thirty years, and copper thirty-five years. Columbia gold and copper mining went further back, but the industry in Saskatchewan, Manitoba, and Quebec commenced quite recently. Smelting of nickel, copper, lead, and zinc had developed concurrently, and large operations were carried on in Northern Ontario, Quebec, and British Columbia. Iron deposits, while extensive and widely distributed, were, as so far discovered, not of that high grade which would prove attractive for development. Coal mined at both coasts and in the vicinity of the Rocky Mountains, had proved a considerable factor in Canadian development. Fifty years ago oil was a product of Ontario, but that was now long forgotten in the modern oil activity in the neighbourhood of the Rocky Mountains in Alberta, where oil was produced at a rate increasing during the past few years, almost in geometric progression.

Transportation was a vital consideration in a country with the shape and geographical character of Canada. To the British Empire the transportation routes through Canada were recognised as commercially strategic. In the export of wheat to Europe, the advantage was apparent at the present time of world depression; the low cost of transportation was a vital consideration, but the favourable location of the best qualities of wheat was also a factor. The sea route from Montreal to Liverpool, requiring seven days for passenger ships, was accomplished with not more than four and a-half days in the open Atlantic Ocean. The new C.P.R. vessel "Empress of Britain" was crossing on her regular voyages from Cherbourg and going up to the interior through the Gulf and River St. Lawrence to Quebec in five and a-half days. Water transportation on the Great Lakes had been a factor in Canadian life for a century. It had had its cycles of activity, owing largely to the history of canal construction along the St. Lawrence River, across the Niagara Peninsula to overcome the Falls, and through the St. Mary's River at Sault Ste. Marie, into Lake Superior. During the last decade the traffic through the Welland Canal and on the St. Lawrence Canals had greatly increased, having trebled since 1920 and reached 8,000,000 tons in 1928.

It was by its water power that Canada was gaining notable ascendency. To it could be traced not only marked industrial economic development, but also in large measure social advancement as well, through the distribution of cheap electric power. Notable was the Niagara plant of the Ontario system of 550,000 H.P., the largest yet constructed. Transmission lines were in operation in lengths of upwards of 220 miles, carrying power at voltages as high as 200,000, to most of the industries of the province. Still more notable, however, would be the forthcoming developments on the St. Lawrence River.

Tunnelling in London.

Mr. Harley H. Dalrymple-Hay then presented a paper on "Some London Tunnelling Problems."

To-day, he stated, there were 45 miles of tube railways, double line, and eighty stations within the area covered. London was fortunate in having below it a thick bed of impervious material known as the London clay, which overlay the chalk in what was called the London basin. It was owing to this clay stratum that the economical construction of tube railways, as originated by the late James Henry Greathead, was made possible, since it permitted the shield system of construction to be applied in the simplest and most inexpensive manner possible. The problem of building tube railways in London economically was to place them at such a depth that they were entirely in the clay. That, however, was not always possible, because the upper surface of the clay stratum was so uneven that deep pockets of the valley gravels were at many points encountered. The tunnelling problem, therefore, resolved itself into one of how best to carry out the work, not only in the clay, but also through the water-bearing strata and sands overlying it. The Greathead shield, while an excellent machine for working in clay, was not so suitable for tunnelling through water-bearing strata. It was found that the only way of using the machine was to mine out ahead of it and timber the ground to form a chamber into which the shield could be pushed as the advance was made for each new ring of tunnel. The shield skin at the back enabled the rings to be erected with facility, true to shape and in safety. Greathead, realising the inadequacy of his method of tunnelling when applied to water-bearing strata, designed a machine to be provided with a number of water jets around the cutting edge, through which high-pressure water was applied to loosen the ground sufficiently to enable the shield to advance gradually into it as the gravel and sand were washed away. Such a machine was not put to practical test, because of the danger of collapse of the ground over the tunnel at the rear end of the shield, as it was moved forward. That would gradually extend to the surface and cause damage to the public streets and property above. Therefore a new type of shield was developed to overcome that difficulty of working in water-bearing strata. That method of working was known as the "hooded shield and clay-stopping system" and was carried out under compressed air. It needed the employment of a special type of shield with a projecting cutting edge or hood of considerable strength and integral with the shield skin. Under cover of this hood the miners worked in safety and attacked the gravel face by scratching out a series of small holes 2ft. long, 1ft. wide and 1ft. high in advance of the cutting edge, the upper part of the pocket holes so formed being purposely mined some 2in. or 3in. radially outside the skin. When a pocket hole was formed it was at once filled with balls of puddled clay well rammed into it. This at once stopped the escape of compressed air, and in that way an annular ring was formed of an artificial stratum of puddled clay, which allowed the cutting edge of the shield to be easily pushed into it. An important advantage was that the shield could bury its cutting edge in the face before the actual mining of the face itself was proceeded with, an operation which could then be carried out in perfect safety under the protection of the hood. Mr. Dalrymple-Hay then described a number of special problems of construction which were found in dealing with parts of the tunnelling scheme. They included the work of cutting the tunnel under the Thames for the extension of the Hampstead tube to Kennington, the construction of an escalator under Waterloo Station, and the construction of Piccadilly Circus Station. The last named presented difficulties because of the large amount of traffic in the Circus and the many pipes put underground. The first operation was the cutting of interceptor trenches at the junction of each street with the Circus and finding in that way how many pipes, cables, &c., came into the Circus at each such point. Then a 12ft. diameter pipe subway was driven round the Circus and connected to each interceptor by a vertical or inclined shaft, without disturbing the surface. The work under the roadway was entirely carried out by mining methods from below. To enable this to be done with safety, long sections of rails grouped in sets of three, of sufficient strength to permit of mining holes 8ft. in width being formed thereunder, were introduced to form a shallow system of girdering to carry the traffic preparatory to mining below it. The steel girder work for the upper station was put into position in headings driven from the working site, cut under the rail grids. When one was put in a second one was entered, and further girders were threaded under the roadway as a space was excavated for them on the site of the already constructed work. It was only recently possible to arrange for permanently waterproofing the roof. That was being done by introducing lead above the concrete on a thick bed of asphalt and further covering it with the same material before introducing the concrete bed of the road.

Sir Ernest Moir spoke of the work done for the Underground Railways by the author of the paper as being the result of an outstanding return to an old process. He referred to the engineer taking responsibility for his work and not leaving it to be borne by the contractor. As Mr. Dalrymple-Hay supervised such things personally, he always got the miners on the job to do things well. He decided what should be done, then went down with the men and showed them what to do, and led them while it was being done.

Mr. J. S. Wilson described the thoroughness of Mr. Dalrymple-Hay's endeavours to prevent hitches by telling the story of the introduction of wooden models of girder through a road hole in Piccadilly Circus to ensure that the real work with the actual heavy girders could be carried out without fouling anything and so causing delay and obstruction.

Fifty Years of Electrical Engineering.

The last of the series of papers dealt with on Monday was one giving the story of his early experiences in electrical engineering by Professor Elihu Thomson, which was entitled "Pioneering in Electrical Engineering Half a Century Ago."

In this contribution the author stated that it was not for nearly a quarter of a century after Faraday's

discovery of the principles of electro-magnetic induction that machines became available for the lighting requirements of lighthouses. At the International Exposition in Philadelphia, Pa., in 1876 there were but two types of dynamo-electric machines shown, one being the famous Gramme machine. At Paris in 1878 the chief electrical feature was the illumination of the Avenue de L'Opera and Place de L'Opera by Jablochkoff electric candles, supplied with alternating current from Gramme machines.

In 1875 the author of the paper made for his own work a small dynamo, which could also be used as a motor. It had two alternative armatures, one of the Gramme ring type and one of the Siemens form. In 1877, with his colleague Houston, the author entered seriously upon the development of electrical plant. In those days the use of iron sheets for laminations was not possible, although the advantage of so doing was fully appreciated. No suitable iron sheets were available and punch press work was not in a satisfactory state of development, while the cost was considerable. In 1878 the author undertook the construction of a machine weighing 400 lb., for which he carried out all the work himself except the making of the castings. On that set there were four field coils and means were provided for their connection in series, in series parallel, or entirely in parallel. It was also possible to connect up four armature circuits in similar fashion. On the shaft of the machine were four collector rings and the machine had brushes, to enable it to be used as a two-phase set, or one supplying two separate single-phase currents. In connection with this machine it was of particular importance that it was planned for use in trying out a transformer installation. That, as far as was known, was the pioneer endeavour in the highly developed transformer system, the elements of distribution so vital in the transmission of alternating currents. In spite of that, it was only after a long contest in the United States Patent Office that priority was given over a number of claimants. A machine made in 1879 was employed to light an all-night bakery in Philadelphia, which set was now in the National Museum in Washington. On the basis of the operation of that generator, Messrs. George S. Garrett and Thomas H. McCollin undertook to begin the manufacture and exploitation of what became known as the "Thomson-Houston system of arc lighting." In the machines the collecting brushes on the commutator were moved so that parts of the armature coil winding on reduced load or on short circuit of the machine were generating, while others were being used as motor coils, involving, in consequence, a reduction of the power required to maintain the standard current in circuit with a less number of lamps in use or with reduced resistance. No attention at the dynamo was needed.

From the start it was recognised that the provision of three collector rings, instead of commutator segments, would make the machine an alternator of three-phase character, and in the original patent papers that construction was described. In 1882 a three-coil machine with a set of three collector rings, one for each phase, was built for a special purpose and constituted, it was believed, the first example of a construction foreshadowing the windings and connections of the great three-phase generators of to-day. An important feature of the arc machine was the device often referred to as a provision for "blowing out the arc and thus preventing destructive action on the commutator." The true function of the air blast had, in reality, little to do with the blowing out of sparks, but it had emphatically to do with the maintenance of the lights in the circuit; it was to ensure their steady operation without sudden interruptions owing to what was termed "flashing over" at the commutator. Machines of that type were later constructed to run seventy-five to eighty arc lamps in series from a single three-segment commutator and a single three-coil winding on the armature. The air blast prevented the reversal or formation of the alternating arc and obviated flashing over, even though the commutator surfaces were liberally oiled.

Professor G. W. Osborne Howe, in opening the discussion, said many people spoke as though, when Faraday's experiments were conducted, everything had been done. That was far from being the case. It was many years after Faraday's work that commercial types of machines became available. It was easy to look back and say everything was so simple and obvious, after Faraday's work, but there was a great amount of work to be done before practical reliable plants could be sent to work for public and private supplies. Even Lord Kelvin, then William Thomson, in 1863, thirty years after electro-magnetic induction had been discovered, regarded the development of dynamos as being a questionable activity. He wrote on March 4th of that year to Professor T. Andrews, of Belfast, a letter regarding the Holmes electric light apparatus and a Nollet plant. In that letter he stated: "I know nothing more of the matter, except that Nollet does not reverse his connections and therefore does have alternately reversed current in his flame; whereas Holmes does reverse and does not have reversals in the flame. Thus Nollet escapes the commutator, a great evil, and gets a flame which does not burn one of the points more than the other—a small but sensible benefit. The reverse of each proposition applies to Holmes. The commutator is a frightful thing. . . . But I believe a large voltaic battery will be more economical than any electro-magnetic machine. I am not quite confident about this, but shall be soon, as I am getting a larger voltaic (120 element) crude carbon (zinc and one liquid, *i.e.*, dilute sulphuric acid) and I shall soon learn how expensive its habits are." From that extract it was obvious how little the great intellects of that day knew of what a revolution Faraday's work brought into the lives of the people. There was thus all the more reason for appreciation of those who developed the work and brought it to successful application.

After several professors had spoken about the author's work, Sir Alfred Ewing expressed the great pleasure they all felt in hearing of the mysteries of early electrical work from a pioneer who was responsible for much of the development, and Professor Elihu Thomson replied that such pleasure could not be greater than his own in the heartiness of his reception.

(To be continued.)

Coal Face Machinery.

An exhibition confined entirely to machinery employed at the coal face in mines, either for coal-getting or for loading and conveying, was opened in Sheffield on October 2nd and will close to-morrow, Saturday. The exhibits are all provided by members of the Coal Face Machinery Exhibitors' Association, by which Association the Exhibition has been organised, and is thus not exhaustive of either makers or types of machines. At the same time, it is well representative of the machinery now available. The adoption of mechanical appliances is gaining ground in all industries owing to the increased outputs and reduced costs which thus become possible. The attainment of these benefits in practice is, however, only possible when the plant employed is capable of giving regular and continuous service, with freedom from breakdown and low maintenance charges. This calls for simplicity and the elimination of all unnecessary adjuncts, combined with a high standard of design and workmanship. Nowhere are the conditions more onerous than at the coal face, and the Exhibition provides convincing evidence that the importance of attention to detail is fully recognised and met.

On the stand of Mavor and Coulson, Ltd., is shown, for the first time in this country, the M. and C. Joy loader. This machine has attracted considerable attention and has possibilities, apart from its use in the mine. On the sloping end of the loader there are two oscillating arms, which gather the coal at floor level and feed it on to a travelling chain scraper conveyor, the total length being 20ft. and the height 3ft. The rear portion of the conveyor can be swung round 45 deg. to either side by hydraulic jacks, other jacks being provided to raise or lower the rear portion of the conveyor and to raise the gathering head for flitting. The loader is carried on caterpillars having change gear, giving two speeds. One electric motor drives the whole loader and runs in one direction the whole time. The weight of the loader is 4½ tons, which is relatively light for the work it performs, since it is guaranteed to load 1½ tons per minute in loose coal. The coal is delivered into a hopper having splayed sides to load the belt centrally and gradually, giving the coal its correct initial speed and providing a cushion of small coal, which tends to lengthen the life of the belt. The troughed belt conveyor specially designed for use with the Joy loader is only 13½in. high. As in all M. and C. troughed belt conveyors, inverted troughing forms a light, rigid structure supporting the belt-carrying idlers and completely protecting the return belt—Fig. 1.

Three chain coal-cutters are shown. In the M. and C. Arcwaller the slewing movement is given by gear drive from the main gearing, which transmits power to the cutter chain. The speed regulation and control is by means of a friction feed of the ratchet type, combined with a screw-actuated cam plate. The jib can be slewed at any speed up to the maximum without the use of a rope. Every provision is made for rapid cutting and flitting, all controls being under the control of one operator. Duplex picks allow a place to be cut in either direction, saving time in turning the picks. Besides the actual machines, skeletons are shown of the driving motors and gearing of the Samson (H model) and Low Seam Samson (M model) long-wall machines, showing the strength and simplicity of the working parts. The latter machine, only 12in. high, has the power and cutting capacity expected of a full-size

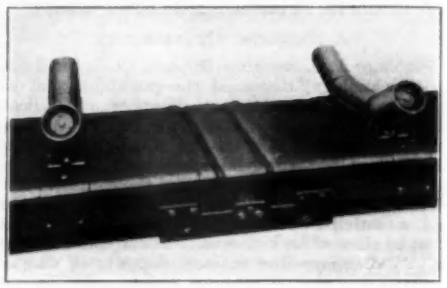


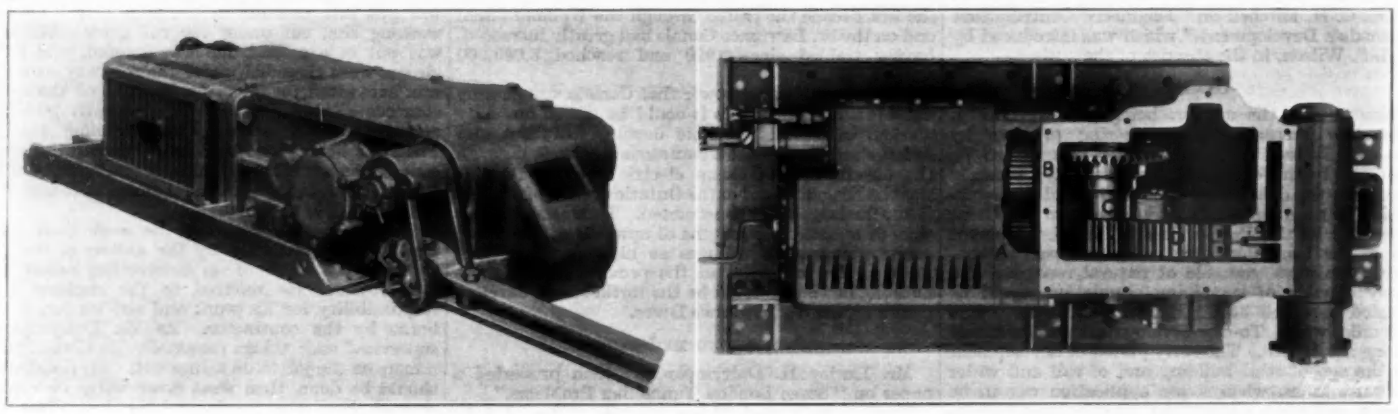
Fig. 1—Troughing for Conveyor—M. and C.

coal-cutter. Two gear trains are provided for haulage, giving, in conjunction with a ratchet feed and cam plate, cutting speeds from 10in. to 50in. per minute, and flitting speeds from 4ft. to 20ft. per minute. The 12in. M. and C. Bar coal-cutter is the only machine of this type in the Exhibition.

The M. and C. electric driving gear—Fig. 2—is shown coupled to a shaker conveyor. It has an A.C. motor and is only 16in. high. All the housings are cast solid with the gear case, maintaining the bearings and gearing in accurate alignment. The trunnion block, which connects the driving arm with the coupling rod, allows the gear to run even though slightly out of line with the drive. A plan of the moving parts of this gear is shown in Fig. 3, where A is the motor pinion, B the spur wheel and bevel pinion, C the bevel wheel shaft and D the spur wheel and crank pin. The crank shaft bearing is carried inside the spur wheel. The other exhibits of Mavor and Coulson, Ltd., are 5 H.P. and 10 H.P. belt-driving gears, a flat belt face conveyor, a double-acting shaker-conveyor air engine, and a troughed belt gate-end loader.

On the same stand are shown examples of the switchgear made by the subsidiary company, M. and C. Switchgear, Ltd., including remote control and automatic circuit breakers. These are made both air-break and oil-immersed. For mining work they are made flame-proof, but the same substantial construction is employed in the switchgear supplied for industrial purposes.

The exhibit of Hardypick, Ltd., includes the "Hurd"



Figs. 2 and 3—Electric Driving Gear—M. and C.

chain longwall coal-cutter. This machine was designed and patented by Mr. F. W. Hurd, consulting engineer to the Hardypick Company. It is built up in five parts, *i.e.*, motor, switch, haulage gear, gear-head and turntable with jib and crane. It may really be regarded as consisting of three units, the driving motor in the centre, the haulage mechanism and the gearhead, each of which is complete in itself. This is now the generally accepted arrangement in coal-cutter design, but it is interesting to note that, in a description we published of the Hurd bar machine about thirty years ago, we made special comment on this feature. The motor, carefully designed for coal-cutter duty, is of liberal rating and very robust construction. The first drives for the haulage gear and the cutting mechanism are each rigidly fixed to the ends of the motor shaft. The switch is also of very robust construction,

the star-delta starter formerly employed being now dispensed with. It is carried in a separate cast steel switch-box, the trailing-cable plug being interlocked with the switch so that it cannot be either inserted or withdrawn unless the switch is in the "off" position. The haulage gear embodies a feature of particular moment, which attracted much attention. This is a uniformly variable speed from zero to full speed, with instant release. There are two trains of gears, the first motion gear for flitting and the second motion gear for jibbing in and cutting. The patented variable speed gear operates on either the first or second motion.

This variable speed gear, although it has only been applied to the coal cutter, presents possibilities of wider use, and a detailed description will no doubt be of interest. The motor shaft A, Fig. 4, drives the three-throw crank D by

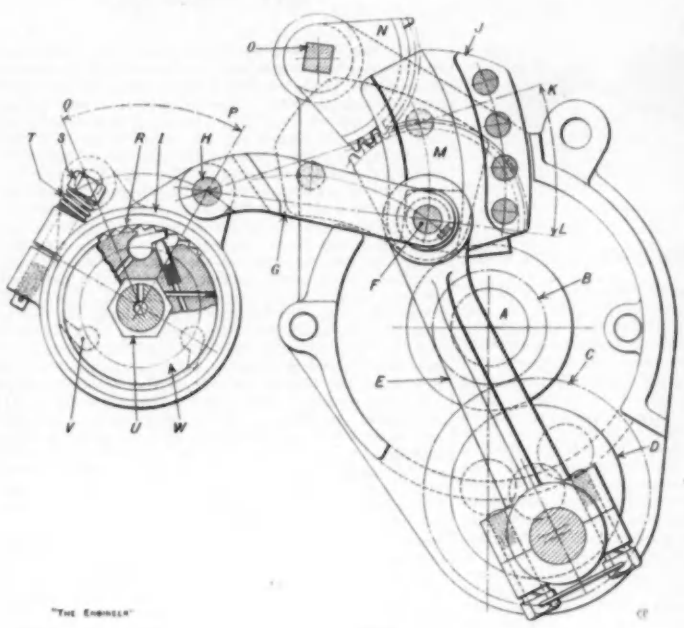


FIG. 4—VARIABLE SPEED GEAR—HARDYPICK

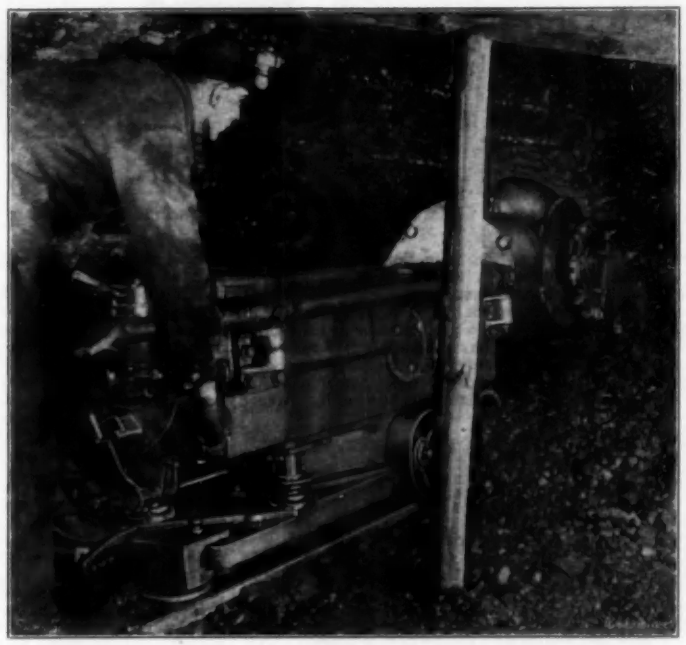


FIG. 5—UNIVERSAL HEADING MACHINE—A. B.

means of the pinion B and the spur wheel C. There are three sets of link gear as shown. The crank pin is coupled by a connecting-rod E to the connecting-rod pin F mounted on a block sliding in the quadrant J. The pin F is further coupled by the link G and pin H to the ratchet strap I. When the quadrant is in the position shown the slot in it is an arc of a circle with centre at H; the link consequently only swings about this centre and no motion is transmitted to the ratchet strap. When the quadrant is moved forward by means of the sectors M and N, operated from the control shaft O, an oscillating motion is given to the ratchet strap. The amount of this depends on the position of a control lever on the front of the machine, which is connected to the shaft O. At the full-on position of the quadrant, indicated in dotted lines, the ratchet strap travels through the arc Q P. In order to allow for possible jamming a peripheral friction drive is provided between the strap and the ratchet wheel R, the pressure being regulated by the bolt S and spring T. Motion is communicated to the feed shaft U by the pawls V mounted in the drum W. It will be clear that as there are three sets of driving gear, following each other at intervals of 120 deg. and engaging in turn with the ratchet drum, continuous rotation is given to the feed shaft. The variation in speed during each revolution is little and there is a noticeable absence of shock in engaging the ratchet pawls.

The haulage frame is of steel divided across the horizontal centre line for convenience of assembling or removing the gears. The diameter of the haulage rope drum is the full width of the machine, there being no guide pulleys or rollers. The drive to the cutting chain sprocket is arranged so that no part of the pull of the chain is transmitted to the gear head. The slewing is always operated on the pack side, and is effected by means of a rope and chain from the haulage drum. The motion is very smooth and the arrangement simple. The jib bracket is cast with the turntable, being very rigidly held and supported on the full width of the machine. Should it be necessary to raise the cut this is effected by three lifting screws which elevate the whole machine to any height up to 14in. above the floor level. For greater heights the jib can be inverted. The cutter box and cutters, or picks, are of entirely new design, covered by patents. The pick is machined with a taper in two directions, which effectively secures it in the box provided with corresponding slots. The picks are simply driven into or out of these slots, no set pins being employed. Two sets of boxes are fitted, one for each direction of cut. The empty boxes serve to bring out the cuttings. Every third box, of those in use, carries three picks, the intermediate ones having each two picks set at different angles, giving seven positions in all.

In addition to the Hurd coal cutter, the Hardypick Company shows a number of air-driven coal and rock drills and electrical heading machine, &c. A handy little piece of apparatus which is of general utility is the Sylvester type hauling appliance with hold-fast attachment. The Sylvester consists simply of a toothed rack bar, one end of which is anchored. A rack box, into which a haulage chain is linked, slides over the rack, being racked along it by means of a suitable lever handle. The new feature is a simple claw attached to the end of the rack to engage with the hauling chain and take the strain of it when it is desired to move the rack box along the rack on reaching the end of the stroke.

The exhibits of Anderson, Boyes and Co., Ltd., include their "AB Twelve" and "AB Fifteen" electric long-wall coal cutters. The former is 12in. high with a 30 H.P. squirrel-cage motor, and has been designed to tackle effectively the thinnest workable seams. The "AB Fifteen" is a specially powerful machine fitted with a 50 H.P. squirrel-cage motor, the height in this case being 15in. Both machines have star-delta switches, which are housed in the motor compartment. They can be fitted with compressed air turbine motors, one suitable for the "AB Fifteen" machine being shown. The haulage gear is of the rope type, a spring-loaded friction clutch being provided, which can be adjusted to slip when the maximum load on the haulage rope is reached. A direct gear drive is provided for flitting purposes, while variable cutting speeds are secured by means of a ratchet gear with cam plate. Ball or roller bearings are employed throughout. There is also on the stand an Arcwall coal cutter mounted on a self-contained power propelled truck. This machine is equipped with a gear head specially designed to suit the Arcwall system of cutting, enabling the jib to be swung through a large arc. An imposing machine is the "AB" universal heading machine, which is of the Arcwall type, but in addition to the usual slewing motion the head can be rotated so that it can cut on the inclination of the seam and make a shearing cut, either vertically or at any angle. An illustration of this method of use is given in Fig. 5. All operating controls are grouped at the driver's end, as will be seen. The jib is slewed or swung by totally enclosed gearing and the range is such that cuts can be made in any position from the floor up to a height of 4ft. 6in. above floor level. Shearing can also be done within the same range. This is the only machine of this type on view and is to be put in service in the Sheffield district after the close of the Exhibition.

A gate-end distribution circuit breaker board, which is shown by the same firm, comprises five panels suitable for controlling two coal cutters, two conveyors and a gate-end loader.

The circuit breakers are of the air break type, the board being of unit construction. The cases are built up of strong steel plates welded together and having wide

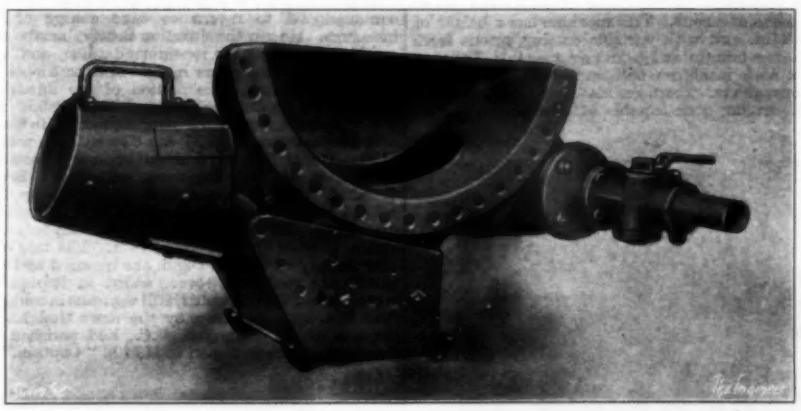


FIG. 6—STOWING JET—MECO

machined flanges, rendering them flame-proof as required by the regulations of the Mines Act.

The exhibit of the Mining Engineering Company, Ltd., includes electric shaker conveyors, a gate-end loader, belt conveyors and driving heads. A "Meco E 22" electric shaker driving gear with 15 H.P. motor is shown driving roller type troughing. The reciprocating motion is produced by a simple crank gear so arranged that different velocities are obtained in the extreme ends of the stroke. The crank is connected by a short connecting-rod to a sliding crosshead enclosing a buffer spring to eliminate mechanical shock. In conjunction with this conveyor the "Meco" pneumatic gob stowing machine is shown. This system of stowing has been considerably employed on the Continent, but has not been adopted in many instances in this country. The stowing jet shown in Fig. 6 is suitable for horizontal or vertical stowing and is capable of throwing stowing material up to 4in. cubes a distance of 10ft. and smaller material 30ft. The principle upon which it acts will be understood at once from Fig. 7. The stowing material can be fed into the jet by means of either a shaker or belt conveyor. A flat belt conveyor, as used at the face,

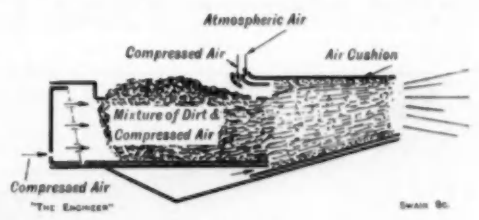


FIG. 7

is shown, complete with driving head, tension drum and the latest type of patented spill-proof plates.

The Sullivan Machinery Company shows an improved type of long-wall coal cutter built of steel throughout, all cast iron being entirely eliminated, fitted with an electric motor normally rated at 30 H.P. When arranged for cutting a 5in. kerf the machine is 12in. high. A complete compressed air motor, which is interchangeable with the electric motor of this coal cutter, is also shown. The most prominent exhibit is a complete compressed air slusher outfit. It comprises an air turbine double drum haulage weighing 680 lb., which is mounted on a portable loading slide weighing 4500 lb., Fig. 8. The haulage gear is arranged to operate a 36in. box type scraper, weighing 490 lb., by means of a main sheave block mounted on the rear end of the loading frame, and a tail sheave block at the end of the heading. This machine is used for the mucking of hard rock headings, in driving tunnels for water power schemes, &c., as well as for loading coal, and is equally applicable to work above ground, such as for storing and reclaiming loose material.

Two long-wall chain coal cutters are shown by British Jeffrey-Diamond, Ltd., one being a 30 H.P. electric undercut machine and the other a 40 H.P. compressed air overcutter. As the result of experiments underground important modifications have been introduced as compared with the former standard machines. Roller bearings have displaced plain bushes on the intermediate and main sprocket

driving shafts of the cutter unit. Ball journal and thrust bearings are also incorporated to take the thrusts set up under heavy cutting. High-pressure grease-gun lubrication is arranged, the grease cups being easily accessible. The gear case has been made practically oil-tight to provide for the possible use of an inferior kind of grease, which might tend to liquefy at high temperatures, a special oil-retaining pad being fitted in the sprocket mounting. The

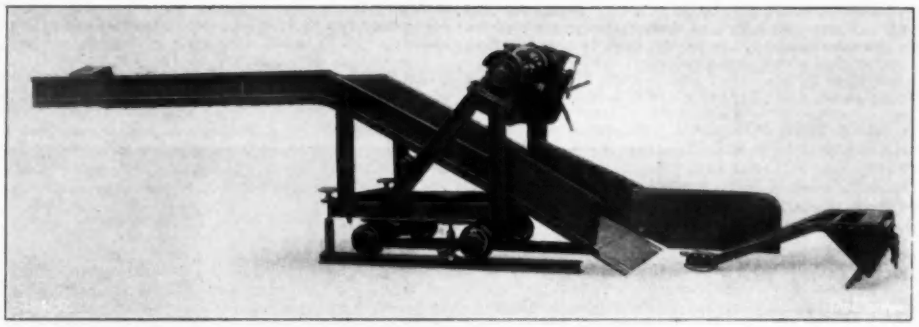


FIG. 8—LOADING SLIDE AND SCRAPER—SULLIVAN

general arrangement of the reduction gearing, as on previous models, is retained, together with the skeleton cover, whereby the machine can be run for inspection with the main top cover removed. It is possible readily to arrange the machine to cut at floor level or at dead floor level. The simple rope drum, with two guide rollers, is retained, together with a control for changing from slow cutting speed to fast haulage speed. The control for variation of haulage speed when cutting is obtained by altering

FIG. 9—COAL CUTTER—BRITISH JEFFREY

the number of teeth engaged by the ratchet. Previously this variation was obtained through a disc rotated by hand, but a link motion positively operated and with separate definite locating positions is now provided, as shown in Fig. 9. On the overcutting machine a turret type cutting unit makes it possible for the jib to be swung completely over the body of the machine, an arrangement of practical value when flitting or turning round at the end of the face.

A new form of scraper chain has been embodied in the Blackett scraper chain conveyor shown, Fig. 10. The return chain is totally enclosed along the whole length of the conveyor, and an improved form of telescopic return end is fitted. In conjunction with the Class X Mark 7 electric jigging conveyor driving gear there is exhibited a length of troughing arranged with the "R.S." method of rope drive trough connection. The driving gear is only 14¾in. high and has a 12 H.P. squirrel-cage motor. With the "R.S." method the drive is on the ropes and not direct on the trough, minimising wear and tear and prolonging the life. Further, the moving over of the conveyor is much facilitated. A scraper chain gate-end loader carried on wheels to suit tub rail gauge is also shown. It is built with 10ft. 6in. overhanging delivery section, at a height of 3ft. 6in. or 4ft. 6in. above rail level, and the top of the receiving end is only 9in. above rail level. The scraper chain is composed of channel section scraper bars spaced at 2ft. intervals, with a hardened steel chain at each side running in the main framework of the loader. In addition, a four-unit distribution switchboard mounted on a combined bus-bar chamber and sledge is shown, along with a number of switches.

Hugh Wood and Co., Ltd., show a number of Eickhoff conveyors, driving engines, and haulage gears. In the Eickhoff trolley wheel conveyor the rolling elements are not loose, but are securely riveted to the conveyor pans. In the new Eickhoff link connection for all systems of shaker conveyors there are no loose parts, the link being hinged on one end of the trough and engaging with a lug on the next trough. The connection can be quickly and easily made or loosened. The new "MED" compressed air reciprocating conveyor engine is preferably used double acting, although it can operate single acting. In this engine the guide rods on both sides of the cylinder, which have proved so successful on the single-acting engines, have been retained. The guide rods are attached to a crosshead, to which the piston-rod is connected, and also to another crosshead on the main side of the engine. The latter crosshead has a forked eye for the connecting-rod. The Eickhoff short conveyor is a combination of shaker conveyor, side-drive connection and double-acting engine. It requires no assembly or alignment, being a complete unit, and can be fixed quickly anywhere by means of two props on the bed-plate. The conveyor can start with a length of 10ft. and can be extended by the addition of further conveyor pans at either end. The engine fitted is capable of handling a length of conveyor up to about 100ft. on the level and 160ft. on down gradients.

The firm also shows a "Huwood" belt conveyor, the special feature of which is that the troughs forming the framework are provided with dowel pin flexible joints, which ensure the correct alignment of the belt frame and at the same time permit the frame to accommodate itself to an uneven or undulating floor. These dowel pin flexible joints are part of the troughing sections themselves, there being no loose fittings to get adrift.

The exhibit of Cowlishaw, Walker and Co. includes "Senior" and "Junior" all-steel long-wall chain coal cutters, in which the depth of undercut varies up to 8ft. and 6ft. with the respective machines. In the "Senior" the jib is swung round under the coal by means of totally enclosed gears, being automatically stopped on arriving at the cutting position. In the other machine the jib is slewed by means of a rope. This machine has a height of 12½in. with 4½in. cut, with variable cutting speeds from 7in. to 60in. per minute and a flitting speed of 60ft. per minute. In both machines ball and roller bearings are employed throughout. There are also shown on this stand an electrical driving gear capable of operating a shaker conveyor up to 160 yards in length and a compressed air shaker conveyor drive.

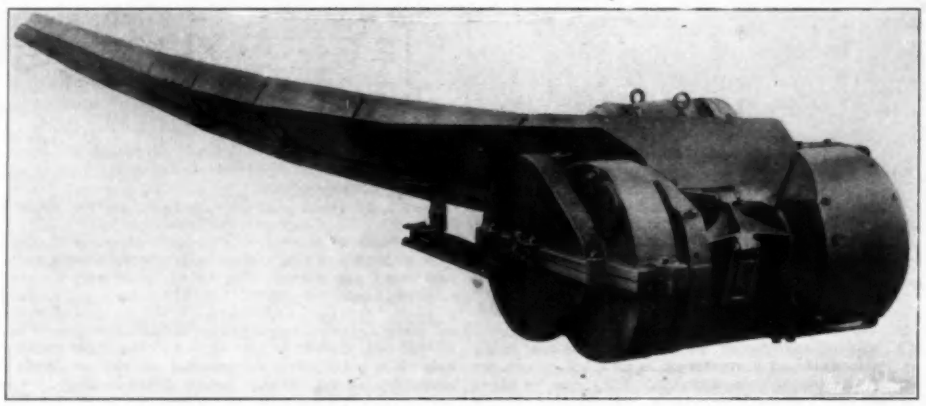


FIG. 10—BLACKETT SCRAPER CHAIN CONVEYOR—BRITISH JEFFREY

Richard Sutcliffe Ltd., shows a gate-end loader having a 24in. belt, which is fitted with spring steel cross bars to prevent the coal from rolling back, while using a fairly steep incline. The overall length of the loader is about 21ft., and the weight 35 cwt. A face conveyor driving head shown is of a new design. A 12in. auxiliary drum is fixed well in front of the driving head and above the base, giving a clearer delivery into a gate-end loader or conveyor, with less raising of the delivery head. The two driving drums are 15in. diameter, rubber covered and geared together. The conveyor framework consists of troughs 6ft. long and 20in. wide with side plates to prevent coal being thrown on the return belt. The height of the top belt above the floor is 7in.

The Uakside Engineering Company, Ltd., shows an electric chain coal cutter having a 5ft. jib, arranged for cutting at floor level. This machine is 15in. high and weighs 4650 lb. The speeds provided for cutting are from 6in. to 28in. per minute, while that for flitting is 25ft. per minute. The motor develops 25 to 60 H.P. The company also shows a 15 H.P. electric shaker conveyor driving unit arranged for side drive, a compressed air shaker conveyor engine, and a reciprocating haulage engine.

SIXTY YEARS AGO.

THE tale which was begun when John Burgoyne—the natural son, some said, of Lord Bingley—was born in or about 1730, touched history, romance and tragedy at many points before it worked out to its end a hundred and forty years later. Before he was thirty-two, Burgoyne had joined the Army, run off with the Earl of Derby's daughter, entered Parliament and been appointed a brigadier-general in Portugal. The year 1777 saw him in command of a British force invading the rebellious American colonies from the direction of Canada. Ticonderoga and Fort Edward fell to his arms, but, at Saratoga, he was hemmed in and forced to surrender. His defeat proved to be the turning point of the war, but he survived the indignation expressed against him at home, and in 1782 he went to Ireland as commander-in-chief, where he spent his closing years writing poetry and plays. In that same year his son, John Fox Burgoyne, was born. The boy's godparent, his father's steadfast friend, Charles James Fox, gave him his second name. At Eton he fagged for Hallam. Before he was fifteen, he was at the Woolwich Military Academy, and by 1798 he was a lieutenant in the Royal Engineers. In 1800 he was in Egypt under Abercrombie, and showed such abilities as an engineer officer that, subsequently, Sir John Moore specially applied for his inclusion in the expedition to Portugal, which was being prepared. With the rearguard during the Retreat, he blew up the bridge at Benevento, with the pursuing French upon it, and later, at Corunna, was one of the party which laid Moore slowly and sadly in his grave. Escaping in the transports, he returned to England, but was quickly back again in the Peninsula under Wellesley. He was in all the principal battles and sieges of the campaign, and became not only engineer officer in command, but Wellington's trusted adviser. From the Peninsula he went with Packenham and Lambert to New Orleans, and distinguished himself at the attack on Fort Bowyer. Then Napoleon escaped from Elba. Burgoyne was to have joined Picton's force in Flanders, but was delayed and missed being present at Waterloo. He returned with the Army of Occupation from Paris in 1820, but his fighting days were not yet over. During the Crimean War he was present at the battles of the Alma, Balaklava and Inkerman, and conducted the siege operations at Sebastapol, until he was recalled in 1855. Between Waterloo and the Crimea he showed that he had other qualites besides those of a great soldier. In 1830 he was appointed chairman of the Board of Public Works in Ireland. Burgoyne entered upon his new duties in the spirit of an engineering pro-consul. Under his energising influence a general railway system was planned, flood waters were regulated, harbours, docks and canals were constructed, and the navigation of the Shannon and other great rivers was improved. In 1845 he was recalled at Wellington's suggestion and appointed Inspector-General of Fortifications, but, two years later, there came the time of the potato rot and famine in Ireland. Burgoyne was commissioned to return to take charge of the relief measures. He saw the situation clearly, but the authorities would not act on his recommendations, and within the next two or three years hunger and pestilence swept off between two and three million of the inhabitants. In after years he fulfilled many other public tasks and commissions, and received many honours. He was knighted and became Constable of the Tower. He was a Fellow of the Royal Society and an honorary member of the Institution of Civil Engineers, and died a British Field Marshal. His death occurred on October 7th, 1871, when he was in his eighty-ninth year. His distinguished career was the subject of a lengthy and intimate notice in our issue of October 13th, 1871. The tale of romance and tragedy which had begun one hundred and forty years previously really, however, ended in September, 1870, when the old Field Marshal, still vigorous in mind and body, had been stricken down by the news that his only son, Captain H. T. Burgoyne, V.C., had perished with four hundred officers and men in H.M.S. "Captain."

A SAFETY valve branch nozzle on the superheater header of a high-pressure boiler blew out and was the subject of official investigation. It was fixed in place by being bell-mouthed inside the header and beaded into a recess in the thickness of the plate; but it is said that this beading was not effective. The Board of Trade Inspector says: "I am of the opinion that at a temperature of 800 deg. Fah. the nozzle tends to expand to a larger diameter than the hole in the header at the same temperature. When the temperature is reduced to the cold condition. the efficiency of the expanded joint in the parallel part will be, to a certain extent, destroyed, and the nozzle will then be held in place by the serration and the bell-mouthing. If, as in the case of the nozzle that was blown out, the end was not expanded into the serration, the nozzle would be held in place by the bell-mouthing only. When steam is again raised there will be an end load tending to blow the nozzle out, and the nozzle will then move out until held by the bell-mouthing. This process repeated will, in course of time, destroy the bell-mouthing, and if the movement is not observed and the defect remedied, the nozzle will be blown out."

The End of the Greatest Patent Conflict.

By Dip. Engineer F. SATORA.

For several years the continental technical journals have been occupied with the steam turbine patents of the Erste Brünner Maschinenfabrik, by the application of which steam turbine technics will have new ways opened up for them. The number of patent applications is immense—when we take into consideration all the countries in which patent rights are claimed—but the main interest of the turbine world is concentrated on the so-called "Steam Velocity Patent Application for High-pressure Steam Turbines."

This patent application forms the basis of the Brno (Brünn) novelty, and its author, Dr. Techn. h. c. Ing. J. Lösel (former manager of the steam turbine department of the Erste Brünner Maschinenfabrik, and at present Professor at the Vienna Technical High School), sees in it the real invention of the present-day high-pressure turbine. According to his own account the origin of his work dates back to 1906—his diploma thesis at the Zürich Technical High School.

"In those days," Dr. Lösel said in a newspaper article in the year 1927, "nobody knew how to utilise high-pressure steam, and up to the year 1922 pressures up to 12 or 15 atmospheres and steam temperatures of 300 deg. Cent. were usual. The available calorific drop to the vacuum was approximately 200 cal. With 35 atmospheres and 400 deg. Cent. the calorific drop was increased to about 270 cal., and finally, with 100 atmospheres and 450 deg. Cent. to about 300 cal. In all three cases nearly the same amount of heat was necessary to generate the steam. The possible gain in energy at 35 atmospheres is 35 per cent., at 100 atmospheres 50 per cent., as compared with steam pressures previously usual. Although these gains were very attractive, it was not possible to realise them at first, and the first step was to create a suitable steam turbine to enable the high pressures to be utilised economically."

Dr. Lösel believed he had invented such a high-pressure steam turbine by using small relative velocities of the steam, which, according to his figures, should be considerably under 140 m. per second. Acting on this idea, he developed the design of his steam turbine, which was usually known as the "Brno (Brünn) type," in technical circles. The steam turbine technical people were mainly interested in the statement about the, so to say, sensational figures for steam consumption, which could be attained by steam turbines built according to this principle, and which would considerably increase the economy in working, especially of large electric power plants.

Although this ingenious idea was contested by prominent European steam turbine experts on the point of novelty, and alleged to be a long-known fundamental principle in steam turbine construction, still a number of European firms, mainly German, in so far accepted the descriptions of the great advantages of the "Brno type" that numerous licence arrangements were made to utilise the awaited patents. To exploit these patents a concern of well-known steam turbine firms was formed, among the members being: A.E.G., Friedrich Krupp-Germaniawerft, Maschinenfabrik Augsburg-Nürnberg, Borsig Tegel, and Siemens-Schuckert. The licence holders also included: Messrs. Stork and Co., Holland, and Stabilimento Technico, Trieste, Italy.

The question at stake was not inconsiderable, because, if the E.B. Maschinenfabrik succeeded in forcing their "velocity patents" through in the most important industrial countries in Europe, nearly all turbine firms working with high-pressure steam would be robbed of all the fruits of their efforts up to the present, and would, so to say, be placed at the mercy of the Erste Brünner.

As usual, in such circumstances, a number of opponents arose to contest the patent claims of the Erste Brünner, and in a few countries where patent protection has already been given, pleas of nullity have been brought. At first, these turbine firms worked separately and independently—*e.g.*, Messrs. Escher Wyss, Zürich, in their patent lawsuit against the E.B. in England—but in 1923 a "Steam Turbine Defensive Union" was formed, the members being the most prominent turbine works on the Continent of Europe: Brown Boveri and Escher Wyss, Switzerland; Laval Angturbin, Sweden; Skoda Works, Czechoslovakia; BBC. Mannheim; Waggon u. Maschinenfabrik Görlitz; Bergmann E.W.; Schüchtermann and Kremmer, Germany; BBC. Vienna, Austria; Sté. Alsacienne, Bréguet; Cie. Electro-Mécanique, Cie. Five Lille; Sté. Rateau; Sauter-Harlé, and Schneider-Creuzot, France.

In the same way as in the turbine industry, the professors formed themselves into two groups. On the one side the adherents and advocates of the Brno patents: Professor Guttermuth, Darmstadt; Professor Körner, Prague; Professor Lewicki, Berlin; Professor Stumpf, Berlin; and others. On the other side a host of scientific men opposed to the patents: Professor Zerkowitz, Munich; Professor Krainer, Berlin; Professor Rateau, Paris; Professor Koeniger, Berlin; Professor Miskovsky, Prague, all of whom have taken part in the battle by means of scientific articles, experiments or expert opinion. Only one expert has maintained strict neutrality, and, so to say, kept clear of the battle, viz., Professor Dr. A. Stodola, of Zürich, the greatest authority on the steam turbine, whose classical book, "Die Dampfturbinen," was used extensively by both sides to prove their arguments, either for or against.

In order to prove that the velocity application of the E. B. Maschinenfabrik was an old-established fact, and therefore incapable of being patented, all the turbine literature was literally sifted. The fight was concentrated principally in three countries—Germany, Czechoslovakia, and Holland—which were important because the Patent Offices in these countries examine every patent to see if it represents something new, and, before patent rights are granted, every patent application must be made public, so that any interested party has the possibility to enter protests. In most of the other countries, where the patent regulations are not so severe, and where a patent can be granted in a more simple manner according to circumstances, the "Defensive Union" took no steps. In such countries—whenever there is no question of special interests—it was found preferable to await the course of events, and to let it come to a lawsuit for patent infringement. If in the meantime patent rights were refused in one of the countries in which there was a severe test to find out if it represents something new, the danger of prosecution for patent infringement would be reduced.

A long time passed, during which expert opinions, results of research and proofs from the existing literature from all the world—both for and against the patent—were collected, but it was still impossible to foresee an end to the litigation or the probable result of the lawsuit proceedings. In the meantime, steam turbine construction made immense progress, high-pressure steam turbines with steadily increasing steam pressures sprang up rapidly, so that plants with steam pressures of 100 atmospheres and up are now no longer out of the usual. In nearly every highly developed industrial country, such turbine plants are already in service or at least in course of erection, as nearly every large turbine works has developed its own types, independent of the "Brno design." Although the impossibility of patenting the Lösel idea became clearer as time went on, still there was a lack of certainty as to how the lawsuit would end.

However, in the year 1929 the velocity application and the repeal were rejected in Czechoslovakia—the home of the Erste Brünner; the Dutch Patent Office also decided to refuse patent rights, whereupon a short time later the German Patent Office took up the same attitude. By these decisions it was established that the idea for which protection was desired, viz., to use a small relative velocity of steam in the blade channels for high-pressure steam turbines was not new, and therefore could not be patented.

In Hungary the velocity application, which had already been made public, was contested by a few firms belonging to the protective union. After the unfavourable decisions of the above-mentioned Patent Offices, the Erste Brünner withdrew their application. In Austria the patent application was not even made public. In a few other countries the velocity patents are still in existence. Only in one country—in Poland—the patent dispute, as echo to the three large lawsuits in Germany, Czechoslovakia, and Holland, still awaits a definite solution.

In Poland, where, similar to the practice in some countries in the West of Europe, no specially severe preliminary examination of the patent is in force, the velocity patent rights were given to the Erste Brünner some years ago. However, a short time before the conclusion of the three lawsuits, this Polish patent was the object of a plea of nullity brought by one of the protective union firms having special interests in Poland. According to reports in the daily Press, the Erste Brünner Maschinenfabrik recently withdrew their Polish patent, as the negative results of all lawsuits up to the present left ever decreasing hope of a favourable conclusion—see the *Prager Presse*, August 6th, 1931. This fully voluntary action of the E.B. Maschinenfabrik can be taken as the definite termination of this famous patent conflict.

This patent conflict has lasted nearly ten years, and, when we consider the number and the importance of the firms interested, it is certainly one of the largest, if not the largest, patent conflict that has ever taken place in the domain of engineering. The expenses of the lawsuits in the various countries go into millions—irrespective of the currency in which they are calculated. In the history of steam turbine construction, for which the result of the lawsuit has assured for the future a free development not restricted by any monopoly, this patent conflict is unique, and forms one of the most interesting episodes in the transition from low-pressure to high-pressure turbine construction.

With a view to economising the expenses of administration, it is understood that a merger is likely to be effected shortly between the three Italian steamship lines, Cosulich, Navigazione Generale, and Lloyd Sabaudo. The amalgamation was suggested by Count Ciano, the Minister of Communications, and, in addition to being an economy measure, is in accordance with the Italian policy of concentrating the administration of all such concerns.

Progress of the Internal Combustion Engine.

On Thursday, October 1st, Mr. W. A. Tookey delivered his Presidential Address to the Institution of Automobile Engineers in London. He took as his subject "The Internal Combustion Engine and its Performance," and, by means of numerous tables, showed the positions attained by various types. Not unnaturally, he laid a good deal of stress upon the factor associated with his name. Discussing Units of Output and Consumption, he said: "In the course of my professional work I have had to study very closely the performances of many different types of internal combustion engines using gaseous and liquid fuels. For a systematic comparison of town-gas engines in industrial service and under prevailing shop loads of various magnitudes, it has only been possible to take indicator diagrams and to note rate of gas consumptions. I have found, however, that a very useful indication can be secured by expressing indicator mean pressures in terms of the number of heat units contained in a cubic foot of total cylinder volume—that is to say, piston displacement plus clearance volume. In commercial testing it is impracticable to take sufficient measurements and determinations to express mixture strength as 10 per cent. weak or 5 per cent. strong, and so on. Similarly, it is impossible, in the absence of a dynamometer, to utilise the comparison of so many brake horse-power per square inch of piston area—which is a sort of guide-post used by some specialists. Everyone can, however, determine engine output in the fundamental unit of indicator mean pressure, or of brake mean effective pressure, according to the facilities at hand, and, similarly, it is always possible to count up the number of cubic feet of piston displacement per minute from cylinder dimensions and divide this into the consumption of heat units represented by the fuel used in the same period. The necessary correction for clearance-space volume then gives an easily computed standard, whereby the actual number of units of heat present in a unit of volume can be ascertained and compared with the mean pressures developed by combustion."

We, unfortunately, lack the space to do justice to an address which bristles with facts and must content ourselves by quoting Mr. Tookey's concluding paragraphs.

"I am afraid that, after all, my address has partaken of the character of a lecture, but the subject must excuse such a treatment. I have confined my remarks to facts, and it is for each of us to base opinions thereon according to our own experience and the needs of our daily occupation. I have left unsaid much that could have been included, but I hope that on the information tabulated it will be agreed that mixture strength plays an important part and that progress can be assisted very materially by studying much more closely than the usual statements of pound per brake horse-power permit, the Similarity Curves which may be drawn from the b.m.e.p./Q_t computations. After all, we are all the time confronted with 'heat engine' problems, and the quantity of heat present in each cycle is fundamental as much as the brake mean effective pressure obtained is fundamental.

"The future seems to be with that engine which will be able to secure the coolest charges with least mechanical complication and thus to obtain high output for weight, smooth operation, with high brake mean effective pressure and low cost of manufacture. This means higher rotative speeds, probably bifurcated manifolds to obviate exhaust interference and more valve overlap in four-stroke types.

"I realise fully the value of the experiments now being assiduously carried out in the development of the small high-speed compression-ignition engine, both in the engineering laboratories of our universities and technical colleges, and in makers' own research departments. In lorry engines, for example, the total cylinder volume is only about 0·07 cubic foot, and, as at full-load output only, say, 38·7 B.Th.Us are present in 1 cubic foot of mixture, the internal combustion engineer has to be concerned with the introduction per cycle of no more than 0·00014 of a pound of fuel, and a still lesser amount at lower loads—quantities which even analytical chemists or physicists might well consider microscopic. These small amounts have to be injected several times per second with exactitude of measurement, at correct and unvarying pressure, and at the right and invariable instant. Moreover, variations of engine speed, of temperature and the human element, have all to be considered and provided for. We hear every now and again, from some Rip-van-Winkle in the lay press, that the British engineer is behind the times. It is the fashion to say so. It is not true, and we know it. We also know much more about progress abroad than the non-technical journalist apparently does. Perhaps, one day, he will be as up-to-date and have to do his work within the precise limits of accuracy expected from the members of this Institution."

B.E.S.A. Specifications.

All B.E.S.A. Specifications can be obtained from the Publications Department of the Association at 28, Victoria-street, London, S.W. 1. The price of each specification is 2s. 2d. post free, unless otherwise stated.

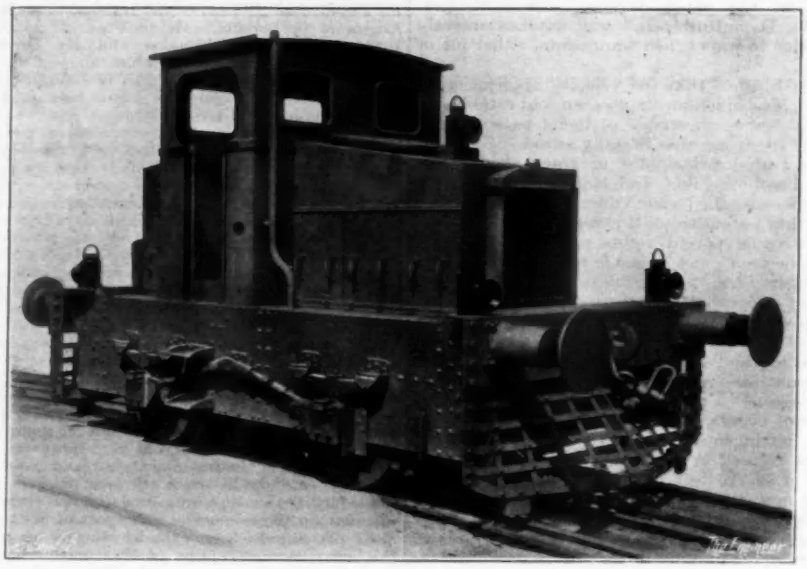
ELECTRIC CUT-OUTS.

The revision of British Standard Specification No. 88, Electric Cut-outs, has now been issued by the British Engineering Standards Association. It is confined to "ordinary duty" cut-outs, the term "ordinary duty" being defined as a function of the maximum short-circuit current in the circuit. The cut-outs are intended for use in two-wire, three-wire and multiphase circuits in which the voltage to earth does not exceed 250 volts. Five sizes are standardised, as against four sizes in the old specification, this difference being due to the old 10-ampère size being displaced in favour of a 5-ampère and a 15-ampère size, corresponding to the standard ratings of plugs and sockets.

The most important point wherein the new edition

INTERNAL COMBUSTION SHUNTING LOCOMOTIVE

AVONSIDE ENGINE COMPANY LTD., BRISTOL, ENGINEERS



differs from the old is the introduction of a scientific test for blowing current, this test being designed—as the result of extensive investigations carried out by the Electrical Research Association—to ensure compliance with the requirement in the I.E.E. Wiring Regulations that the fuse link shall be of such size that it will melt in one minute or less by a current equal to twice the rating of the smallest cable protected by it. This test is at the same time designed to ensure that a fuse carrier and link shall have a reasonable life when carrying its rated current, and provides for the effect of preheating of the fuse carrier and tolerances in the size and composition of the fuse link.

Further new tests introduced into the specification are an insulation resistance test, a test for breaking capacity and a test for temperature rise. Certain general requirements of a constructional nature are also included, but the physical dimensions are not standardised.

STREET LIGHTING.

The British Engineerng Standards Association has just issued a revision of the British Standard Specification No. 307, for Street Lighting. Five new definitions, covering Highway, Carriageway, Footway, Margin, and Kerb, have been included, but the chief points in the revision are in the specification itself. Footway illumination has been included, and a column has been added to Table II., giving the lowest recommended height of the luminous centre of the light source above the ground. The definition of the mounting heights in the 1927 specification as minima had the result, which so often happens when a minimum is prescribed, of the minimum being adopted as the maximum or adequate height, and therefore this column of *recommended* heights was added. In the case of streets lighted on one side only, it is specified that the height of the posts must not be less than two-thirds of the width of the roadway. The spacing-height ratio has been revised. In the 1927 edition, a general spacing-height ratio of not more than 12 was specified, but in the revision a maximum, which should not on any account be exceeded, has been given, varying according to the different classes of installation, and, in addition, a *recommended* maximum has been included in an endeavour to encourage public lighting authorities to diminish the spacing-height ratio wherever possible.

As it was agreed at the American meeting of the International Illumination Congress that "average illumination" should have some place in systems of classification of street lighting installations, a requirement has been inserted that with any tender there shall be given the value of the maximum and average illumination on the roadway, the average illumination to be calculated by a method to be agreed by the purchaser. One method, however, of calculating average illumination is shown in an appendix.

In regard to the question of glare, it was found that even the simplified method of assessing glare given in the 1927 edition of the specification was considered by many of its users to be too involved, and was not being used; therefore no numerical expression of glare has been included in the revision, but guidance is offered to the users of the specification as to the means by which glare may be mitigated.

The plans and diagrams given in Appendix II. to illustrate the positions of typical test points have also been revised.

An Internal Combustion Shunting Locomotive.

THE locomotive shown in the engraving given above has recently been constructed by the Avonside Engine Company, Ltd., of Bristol, to the order of the Indian Store Department, for service on the Indian State Railways —North-Western Railway—under the supervision of the consulting engineers, Messrs. Rendel, Palmer and Tritton. The locomotive is of the Avonside standard type, but with additions and modifications to suit the requirements of the consulting engineers.

The prime mover is a four-cylinder petrol engine, by W. H. Dorman and Co., of Stafford. It has cylinders 124 mm. diameter by 140 mm. stroke, and develops 53 B.H.P. at 1000 r.p.m., with a maximum of 65 B.H.P. at 1450 r.p.m. Starting is effected by hand, the starting handle being arranged at the side of the locomotive in a position convenient for manipulation. The friction clutch is of the inverted cone type, mounted in the engine fly-wheel, the latter having a removable rim to permit of the easy renewal of the clutch linings when required. The gear-box is of the "Avonside" standard design, and provides two speeds in each direction of 3 and 6 miles per hour at 1000 r.p.m. of the engine. The gears and shafts are of nickel steel and were supplied by David Brown and Sons, of Huddersfield. The gear-box is of the constant mesh type, with a bevel wheel reverse, the changes being effected by heavy dog clutches. Ball bearings are fitted throughout the gear-box and Timkin taper roller bearings are provided on the transverse bevel shaft.

The drive from the transverse shaft of the gear-box is taken to each axle by heavy roller chain drives. These chains are of 1¼in. pitch. Wheel centres are of cast steel with rolled steel tires 3ft. diameter on the tread. The axle-boxes are of the "Avonside" special type with outer housings sliding in steel guides, as in ordinary locomotive practice. The inner members of the axle-boxes carrying the journals slide longitudinally in the outer housings, and are anchored to torque rods so that the chain centres are maintained constant when the complete axle-box moves in the guides, due to the action of the springs. The torque rods are fitted with helical springs, which come into action when the chain pull exceeds the normal and thus relieve the chains of shock.

Two independent braking systems are provided. An ordinary hand screw brake actuates cast iron brake blocks on all wheels, and Ferodo-lined internal expanding brakes are fitted to each axle, controlled by hand lever in the cab. The bearing springs, it will be seen, are of the laminated type. I.S.R. standard buffers and draw-gear are provided and a cowcatcher is fitted at each end of the locomotive. The fuel tank has a capacity of 40 gallons. A cooling water tank of 40 gallons capacity is provided in series with the radiator, and the latter is fitted with thermostatic control to ensure maintenance of the correct temperature of the cooling water.

The rated tractive effort of the locomotive at 75 per cent. of the engine torque is 4960 lb. at 3 miles per hour, and 2460 lb. at 6 miles per hour. The weight of the locomotive empty is 12¾ tons and in full working order 12¾ tons.

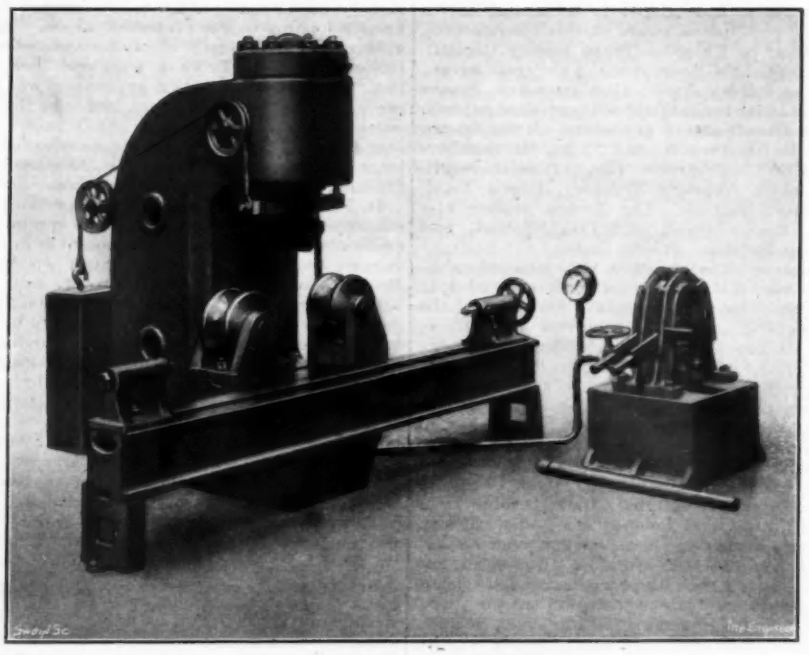
PUMPS FOR STORM WATER SEWERS.

PREVENTION of flooding in a low-lying section of the city of Detroit, with an area of some 16,000 acres, is accomplished by the construction of large relief sewers which reach a diameter of 14ft. at their connection to the pumping station, where the water is raised and discharged to the river. This station is circular, and two 14ft. sewers discharge into a chamber having the vertical suction pipes of four pumps, which number will be doubled later. An unusual feature is that no screens or trash racks are provided, since the pumps are designed to pass spheres of 16in. diameter. During a trial run, one of the pumps showed a temporary decrease in capacity, owing to the passage of wood paving blocks and some clothing. The present equipment consists of four 84in. vertical shaft, single-suction screw pumps, driven directly by electric motors of 2300 H.P., running at 200 revolutions. Each pump has a capacity of 500 cubic feet per second at 27ft. head. The motors operate on 4600-volt, three-phase, 60-cycle current, which is delivered from two independent sub-stations as an insurance against loss of power in an emergency. Priming is necessary, on account of a suction lift of 10ft. to 20ft., and is effected by means of syphons and four motor-driven vacuum pumps, each of which can be connected to any one of the main pumps. In addition there are two sump pumps to drain the suction well during periods of dry weather. The main pumps were designed under a guarantee of capacities of 537, 500, and 445 cubic feet per second against heads of 20ft., 27ft., and 35ft., with an overall efficiency averaging 69·27 per cent. for heads of 20ft. to 30ft. The motors are started by means of push-buttons on a switchboard in the operating-room. Direct current for the fields of the motors is supplied by three motor generator sets.

A Hydraulic Straightening Press.

A SPECIAL form of hydraulic press for straightening shafts of high-grade steel alloy up to 3in. in diameter, made by Hollings and Guest, Ltd., of Thimble Mill-lane, Birmingham, is illustrated by the engraving below.

It is, it will be seen, of the vertical open-gap type, and has a ram 9in. in diameter by 6in. stroke. The gap is 8in. Attached to the ram there is a crosshead, from which there are hung two heavy counterweights to effect the return stroke. The cylinder, pedestal and table are cast in one piece and the table has a machined face to carry the brackets for two rollers for supporting the shaft to be straightened. A Tee slot is provided for bolting down the brackets, so that the span of the shaft can be varied, while the pulleys are grooved to minimise any bruising of the shaft. In front of the press there is a cast iron bed, similar to that of a lathe, with two simple headstocks, between which a shaft can be swung for testing its straightness. The maximum length which can be accommodated is 5ft. Water for the ram is supplied by a double-barrel hand pump, but could, of course, be taken from the main if a high-pressure supply is available.



HYDRAULIC SHAFT-STRAIGHTENING PRESS

A FACTORY is being put up near Huntsville, Ontario, for the production of diatomite from the mud at the bottom of the local lakes. The mud will be pumped out by a suction dredge.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Unsettled Conditions.

THE national developments of the past week have unsettled industrialists in the Midlands and Staffordshire, and there has been a decline in activity on the Birmingham iron and steel market. Business, nevertheless, is still an improvement on what it was a month ago, and although for the present consumers of iron and steel are holding back, the market tone remains bright, and there is little, if any, deterioration in the optimistic attitude towards the future of industry in this area noted last week. It is confidently anticipated that a mandate for tariffs will be given by the electors to the Government of to-morrow, and the bulk of industrial opinion here seems to be that in a new fiscal system lies the hope of trade revival. Naturally at the moment, new business is held up, but with more settled conditions will come a release of this trade, schemes will be proceeded with—though many no doubt will be dropped—and consumptive demand for iron and steel will increase. In some branches of the market, notably the raw iron department, users have during the past few weeks entered into commitments covering their requirements for some time ahead. Some Midland foundrymen have placed contracts to the end of the year. The placing of new contracts in this branch of the market is therefore unlikely to be on any large scale during the coming months, but there is bound to be buying on a small scale. The amount of this movement will depend in some measure upon the rapidity with which the country gets back to normal working conditions again after the election upheaval. In those sections of trade where prices are advancing or likely to appreciate, there has also been some buying as an insurance against contingencies, but, generally speaking, they have been of a sober character, stocks not representing more than a small cover, even at the present rate of consumption. In Midland and Staffordshire factories, short-time working with depleted staffs persists. There is no marked increase in momentum at the works; indeed, in some cases production has been further curtailed. Recently the heavy foundry at the local factory turning out pumps has had to close down for the first time for many years. One of the automobile factories has also virtually ceased production. Firms doing a large export business, of which there are a very large number in this area, are hoping for a speedy improvement in demand as a result of the depreciation of sterling. In a few cases it is reported that better buying is already in evidence. Machine tool makers state that they are deriving benefit from the general expectation of increased business coming along. On 'Change in Birmingham this week the market tone has remained steady. The spirit of those in attendance was moderately bright, though transactions in all departments were below those of a week ago. The future is looked to with more confidence than one might suppose under the prevailing difficult trading conditions, but wisdom prescribes caution.

Raw Iron Buying Declines.

The recent buying movement in the raw iron market is losing impetus as a result, no doubt, of foundrymen and forgemen having satisfied their known or estimated requirements over the next month or so. For a long time now they have been purchasing supplies only just sufficient to cover current needs, but the change of situation nationally led them to expect advances rather than a decline in the future in iron prices, consequently the time was considered ripe to enter into contracts for supplies. In a number of cases it is considered that the supplies contracted for represent no more than a nominal reserve as a precaution against higher selling rates, though in others they are said fully to cover estimated requirements over the next three months. Blast-furnacemen are said to be unwilling to commit themselves into next year. For months past they have been able to buy their fuel very cheaply, much cheaper, in fact, than they can buy it to-day. The fuel market is definitely firmer and Northamptonshire and Derbyshire smelters who wish to make new contracts for furnace coke are being asked at least 11s. 6d. per ton at ovens. Although pig iron prices were reaffirmed by the Central Pig Iron Producers' Association at the end of September, and blast-furnacemen have still to use up stocks of fuel which they bought cheaply, the chances are that before long selling rates of iron will increase. When one notes that there is no substantial increase in activity at the local forges and foundries, it appears obvious that it is the fear of higher prices which has induced merchants and consumers to place forward contracts after refraining from doing so for so long. Be that as it may, local users have now placed themselves in a position to deal with increased business as soon as it comes along. Hematite, which has been in a defenceless position, owing to over-production, is showing the effects of the recent stimulus more definitely than any other subdivision. For East Coast hematite prices 3s. over those recently ruling are now quoted, £3 19s. to £3 19s. 6d. being asked for mixed numbers, delivered Birmingham. Midland forge and foundry irons are unchanged. Derbyshire and North Staffordshire No. 3 foundry pig is £3 6s., and forge £3 1s., while Northamptonshire No. 3 is £3 2s. 6d., and forge £2 17s. 6d.—all per ton delivered at stations in the Black Country.

Steel Business.

Interest in the steel department of the market continues to centre round half-products, for which selling prices have risen further. In the finished branch there is very little change. Orders have in some instances been slightly larger, but they have not been such as to suggest any real improvement in consumptive requirements. Midland structural engineers are not enamoured with future prospects, while the volume of work at present in the yards is relatively small. Structural steel prices are firm at the Association level. Angles are £8 7s. 6d., less 15s. rebate; tees, £9 7s. 6d., less 15s.; joists, £8 15s., less 22s. 6d.; ship, bridge and tank plates, £8 17s. 6d., less 15s. rebate. Boiler plates continue to sell at £9 per ton. Native makers of semis are improving their position as the result of the slowing down of business with foreign rivals. Sales of continental material are practically at a standstill. Here and there a merchant has supplied small tonnages to regular customers to meet urgent demands, but, generally speaking, merchants are awaiting advices from the Continent before putting through deals. Home producers of billets having secured substantial orders have further advanced quotations. Mild steel billets were this week quoted on 'Change in Birmingham at from £5 5s. to £5 10s. per ton. Re-rollers quoted small bars re-rolled from foreign material at £6 10s. upward, and all-British bars £7 5s., and it is thought that these prices will be improved upon in the near future.

Sheet Prices Advance Further.

Galvanised sheet prices have again risen sharply, present quotations being some 10s. per ton in advance of those ruling at the time of writing a week ago. Local makers are now quoting £9 15s. as a basis for 24 gauge galvanised corrugateds. Some manufacturers are not content with this figure, and are asking a further half-a-crown. Dearer steel and spelter have so advanced production costs that sheet makers claim to be entitled to the selling price now demanded. Overseas business is gradually improving, with South America and South Africa as the most prominent purchasers. The home trade is not so good as it was, but mills are better placed for orders, and do not miss this section of the trade as much as they would have done a few weeks back. There has been more animation in the tin-plate market here, a further advance of 2s. having resulted in the placing of speculative orders. Tin-plates have been quoted this week as high as 15s. 6d. per basis box.

Finished Iron.

There are no new features in the Staffordshire finished iron trade, and interest in this section of the market is negligible. Demand is extremely dull, consuming works in the Black Country being short of work and having but poor prospects. Even in the common bar branch, where the change in the position of continental competing material is likely sooner or later to effect the position of Staffordshire manufacturers, there was no real interest displayed, and makers of nut and bolt and fencing bars saw no reason at the present stage to make any alteration in their quotation. Common bars therefore remain at £8 7s. 6d. It was impossible to discover the present value of Belgian No. 3 iron, which competes with Staffordshire common iron. Crown bars are in poor request at £9 5s. upwards, and sales of marked bars are maintained at about recent levels. Prices are unchanged at £12 per ton at makers' works. The call for wrought iron tube strip is reported to be slightly better than of late. Values are steady at £10 10s. to £10 12s. 6d. per ton delivered.

Workless.

A further advance, this time one of 20,275, in the number of unemployed in the Midlands area is recorded. There are now 274,298 wholly unemployed, 143,313 temporarily stopped, and 637 normally in casual employment, making a total for the division of 418,248. This is 126,786 more than in the corresponding week last year. The figures for Birmingham show a slight decline on the week, and stand at 74,872. The whole of the Black Country towns show increases, as does Stoke-on-Trent, but there is a tiny decrease at Coventry.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Locomotive Builders' Prospects.

ROLLERS of steel materials for the locomotive building industry have experienced a very lean time this year among Lancashire concerns engaged in this branch of engineering, and further evidence of the depression is given by the directors of Vulcan Foundry, Ltd., of Newton-le-Willows, in a review of the conditions during the twelve months to the end of June. A number of contributory factors are involved, for it is pointed out that the world-wide financial chaos, the diminution of railway traffic, and the uncertainty as to future types of construction have all helped to produce a virtual cessation of the demand for locomotives by railway companies, and have thus accentuated the very keen competition for the few orders that have been available. The directors, however, strike a somewhat hopeful note when they state that, whilst the duration of the unfavourable conditions cannot be gauged, busy times should follow when deferred indents, as well as current railway requirements, call for supply. More than passing significance may be attached to the further statement that "in the meantime some diminution in the present excessive capacity for production in the industry may possibly occur." In spite of the conditions the directors, after providing for the preference dividend, are able to recommend a distribution of 4 per cent. on the ordinary share capital, compared with 7½ per cent. a year ago, the balance of undistributed profits amounting to £84,820, against £106,355. It may be recalled that early last month the directors of Nasmyth, Wilson and Co., Ltd., Manchester, commenting upon the position of the locomotive-building industry, stated that the number of orders which they had received for locomotives during the financial year was 72 per cent. less than the average for the last thirty-five years.

Textile Machinery Merger in Operation.

Textile Machinery Makers, Ltd., the much-discussed merger of six Lancashire firms of textile machinists, started officially on its career on October 1st, the registered office being at 61, Deansgate-arcade, Manchester. The firms concerned are Platt, Bros., Ltd., Oldham; Howard and Bullough, Ltd., Accrington; Brooks and Doxey, Ltd., Manchester; Dobson and Barlow, Ltd., Bolton; John Hetherington and Sons, Ltd., Manchester, and Asa Lees and Co., Ltd., Oldham, the combined ordinary share capital amounting to nearly £4,500,000. The companies will continue to operate under their original names.

Cutting Down Expenditure on Road Works.

It is understood that the Highways and Bridges Committee of the Lancashire County Council proposes to reduce by about £500,000 the expenditure on the programme for road works. Manchester's programme of road construction, estimated to cost more than £1,500,000, spread over a period of five years, is expected to be postponed indefinitely.

Non-ferrous Metals.

A certain amount of inevitable reaction has been experienced in all sections of the non-ferrous metals market during the past week, although, in the last day or two, a recovery was effected in tin. This metal at the moment of writing is about £2 a ton dearer on balance than it was a week ago, the market having, apparently, overcome the "bearish" influence of the latest monthly statistics, which were regarded as of a disappointing character. Stocks of the metal held in this country continue to contract, and the demand on this side from industrial consumers has been on a somewhat better scale, with, however, little improvement in this respect on the Continent and in the United States. With a decline of about 12s. 6d. a ton in standard brands, copper has lost part of the previous week's gain. Altogether, the demand has been less pressing, and a not too bright view of prospects is being taken, the statistical position at the moment, as it has been for some considerable time, being all against any decided upward movement. The cable-manufacturing industry during the week has taken a fair aggregate quantity of refined descriptions. The lead market has been the chief sufferer from the set-back in non-ferrous metals, and the whole of last week's advance of £1 10s. a ton has been wiped out, although current values are still appreciably above what they were before the departure from the gold standard. In the case of lead, as with spelter, which is cheaper on the week by about 12s. 6d. a ton, the demand latterly has been on a quiet scale.

Iron and Steel.

Notwithstanding that the demand on the Lancashire foundry iron market is diminishing, a natural sequence to the more active forward buying of the past few weeks, the outlook is regarded somewhat more hopefully than it was a month ago, although, as yet, there is not much to show in the way of actual increase in industrial activity. There has, however, been a slight improvement in the rate at which iron is going into consumption in this part of the country, and if the light castings branch, as it hopes to do, benefits materially from a decline of foreign competition on the home markets, deliveries of pig iron should expand. Quotations are firm at 67s. per ton for Staffordshire, Derbyshire and Cleveland iron, 65s. 6d. for Northamptonshire, and about 87s. for Scottish, all for delivery Manchester or equal distance. Lancashire Crown bars continue to be quoted at £9 15s. per ton, and No. 2 at £8 5s., without any appreciable improvement in the demand. Interest in constructional steel on these markets shows little indication of developing, and early prospects in this branch are not favourable. In several other respects, however, interest in steel has been better, rollers reporting an improved inquiry and more actual business. Small re-rolled bars have advanced to £7 basis, with general plates at £8 17s. 6d., joists at £8 15s., sections at £8 7s. 6d., and large bars at £9 7s. 6d. Boiler plates, at about £8 15s. per ton, are not too strong. A certain amount of business has been passing in imported finished products at higher levels.

BARROW-IN-FURNESS.

Hematite.

There is some evidence this week of a little more life in the hematite pig iron market, and this is noticeable among home buyers, who, in the past, have been content to buy just sufficient to keep them going. It is, perhaps, too early to say how foreign demands may develop in view of the exchange rate, but if there is any life at all in the continental and American iron and steel industries business should be more brisk. There is still a heavy stock of iron in this district, and it is not far from totalling six figures, but there is a chance now of the demand overtaking the output, especially as both Workington and Barrow steel departments are taking a fair amount each week. There is a little more activity in the local iron mines, and it is possible that the demand outside the district may improve. Foreign ore remains in moderate demand. The steel market is dull, but here, again, there are possibilities of improvement. Present contracts will not take makers far, but there is a chance of further orders coming to hand. The hoop mill is engaged and the outlook for this local speciality may possibly improve.

SHEFFIELD.

(From our own Correspondent.)

Steel Production.

WHATEVER the future may have in store for the steel trade—and there is a growing hope that it will bring about an improvement—the statistics of production show that no progress had been made up to the end of August, but that, on the contrary, the decline had continued. During that month, the output of steel ingots and castings in the Sheffield area amounted to 67,900 tons, as compared with 70,000 tons in July, and 72,900 tons in August of last year. Included in the total were 19,400 tons of acid ingots, 36,900 tons of basic ingots, and 11,600 tons of other ingots and castings. In North Lincolnshire, the falling off was very striking. The August figures of 22,100 tons established a new low record, the output for July having been 36,500 tons, and that for August, 1930, 37,400 tons. Practically the whole of the

output consisted of basic ingots. There is no better state of things to report at present; in fact, the Lincolnshire production has dropped further, and the steel works there are extremely slack. There is, however, a decided improvement in inquiries for open-hearth steel, and producers report a general rise of confidence. The Lincolnshire makers are hoping to benefit from the increased cost of imported sheet and tin-plate bars.

Pig Iron and Scrap.

The production of pig iron in Lincolnshire in August was only 30,800 tons, as against 35,300 tons in July, and 56,200 in August last year. The outlook for this trade is, however, better. Sir William Bird, chairman of the Staveley Coal and Iron Company, at the annual meeting last week, referred to the fact that the stock of materials was larger than usual. This, he said, was mainly accounted for by the stagnation in the iron trade, and the company's holding a larger stock of pig iron. During the previous ten days, however, there had been a substantial tendency to buy, and the stock of iron was now rather less. Speaking on the following day, Mr. Joseph Ward, chairman of Thos. W. Ward, Ltd., was able to strike a cheering note. His company is engaged in many branches of trade, one of the principal of which is dealing in scrap, and he spoke of the tremendous drop in the prices of that material during the past year. But now, he said, there had been a great change for the better. Inquiries were more numerous at home and abroad; buying at improved prices had begun, and a decided general recovery was manifest in the iron and steel industries.

The Outlook.

Steel makers also report better inquiries, in other departments besides that of open-hearth material; but already fears are being expressed that the improvement may be neutralised by other countries going off the gold standard. Several of the lighter branches are obtaining orders diverted from the Continent. Local file makers are hoping to gain trade at the expense of American files. Large stocks of the latter are held in this country, and I am not aware of any change in the quotations for them, but any further imports would, no doubt, have to be at enhanced prices. There has been a good deal of buying, for forward requirements, by consumers of hematite, pig iron, Swedish iron and steel, who have taken considerable tonnages from stocks in the hands of local merchants.

The Manufacturing Side.

A review of the various departments devoted to finished steel products reveals little change in the situation. There is a fair amount of work on hand in the production of hollow-forged drums, but other heavy industries, like shipbuilding, and railway steel, are still very short of work. No alteration is reported in the condition of the stainless steel, acid-resisting and heat-resisting steel branches. They continue to turn out a large volume of products, and form one of the brightest spots in the local situation. The makers of automobile supplies are moderately well employed, but would welcome an improvement which would bring the demand nearer to the level of a couple of years ago. The season has been an unsatisfactory one for makers of farm and garden tools, although, owing to the unfavourable weather, the demand for certain classes of tools used in harvesting has shown an increase. The bad summer has considerably interfered with the sale of garden tools. For engineers' tools there is still a fair demand from the home market, but the export trade in these tools as well as in high-class tool steels, keeps very low. The file trade has been depressed for a considerable time, and shows little evidence of improvement.

Protective Tariffs.

At the recent meeting of the Association of Chambers of Commerce at Lincoln, the Sheffield Chamber supported a resolution welcoming the formation of a National Government, pointing out the danger of excessive expenditure, and advocating the imposition of protective tariffs. The resolution was carried. Now, in view of the possibility of a general tariff being introduced in the near future, the Chamber has appointed a special committee to consider the details of such a measure and its incidence upon Sheffield trades. At the last meeting of the Council of the Chamber the interesting statement was made that requests were being received for particulars regarding sites available in the city for industrial purposes, and that steps were being taken, in co-operation with the city authorities, to deal with them.

Electrical Rolling of Steel.

A large scheme of expansion in connection with the electrical rolling of steel has just been completed by Brown Bayley's Steel Works, Ltd. The firm has converted the main drive of its No. 1 27in. three-stand reversing mill from steam to electricity. About two years ago it was found that, although the 2000 H.P. steam engine which then drove the mill—and which was made and put down by Davy Bros., Ltd., of Sheffield, about forty years ago—was still working satisfactorily, the boilers would soon require fairly extensive repair. It was decided to change over to electricity in consequence of a report from the firm's technical staff, which showed that new steam plant would cost nearly twice as much as electrical equipment, would occupy double the space, and would involve higher working costs. The main contract was placed with the English Electric Company, Ltd., which had previously installed a 400 H.P. and a 2000 H.P. motor in other mills of the firm. The new installation has been running a few weeks, and its results are so satisfactory that it has now been decided to scrap the old steam engine, instead of keeping it as a stand-by for some months, as originally intended.

New Colliery Equipment.

The latest development of colliery enterprise in this district is the sinking of the Brookhouse colliery of the Sheffield Coal Company, Ltd. The 18ft. diameter shaft has now been completed, and the colliery, when fully equipped, will be representative of the most modern mining practice. It is being laid out for a weekly output of 15,000 tons. Its equipment will include an electric winding engine, hydraulic decking arrangements, and screening and coal-washing plants. The contract for the whole of the electrical equipment was placed with the General Electric Company, which is supplying, in addition to the power-house plant, a Ward-Leonard controlled winding engine, transformers for general distribution purposes, motors for driving the coke-handling and screening plant, &c. The duty of the winding plant is to raise a net load of 15,676 lb. of coal from a depth of 1350ft., with an output of 196 tons per hour. The winding drum is directly coupled to the driving motor, which is a D.C. machine rated at 1150/2700 H.P., with a speed of 43·5 r.p.m. The motor is supplied from the D.C. generator of the motor generator set. A new type of over-winding device has been installed on the headgear. This device incorporates the new feature of the "Whitmore" overwind, which is known as the "landing zone controller," and gives protection against approaching the bank level at too fast a speed.

A Gigantic Pump.

The world's largest pump has been completed by Gwynne-Foster, of Lincoln. It is the first of three which the firm is making for the Middle Level Commissioners for their drainage scheme between Peterborough and the Wash. The pump weighs 88 tons, has a discharge branch 102in. in diameter, and can deliver 1250 tons of water per minute. The three pumps working together would be able to deliver the same quantity of water as the normal flow of the river Thames at Teddington.

Cutlery and Plate.

There has been some improvement in the cutlery and plate trades, but only a few firms are well employed, and, on the whole, there is little relief to the depression which has existed for some years. The output is large, but so much below the normal that, at present prices, it is almost impossible to operate remuneratively. The new financial conditions in the world may bring about some benefit. It is feared that the increased Budget demands will result in smaller sales in the home market during the Christmas season, shopkeepers' purchases for which are on an exceptionally small scale. The great advance in the cost of nickel is perturbing to the makers of electro-plate, with whom it is a base material. Hitherto, the cheapness of nickel and silver have enabled them to produce at competitive prices with the rest of the world. The safety razor industry keeps up well, and the trade has been increased by the entry of new firms, specialising in the penny blade. Thos. Ward and Sons, Ltd., of Wardonia Works, have just received the contract for the supply of Wardonia New Edge razors and blades for the Irish Free State Army for the next twelve months. The firm had held the contract for the supply of razors for the current year, and has secured its renewal in face of keen competition from this country, America and Germany.

NORTH OF ENGLAND.

(From our own Correspondent.)

Iron and Steel Export Trade.

Although the abandonment of the gold standard has given a definite impulse to the Cleveland export trade in iron and steel, and has opened up markets which have been closed for some considerable time past, the new impetus came too late to affect materially the September shipments from the district. Some substantial sales of iron have been made to France, Germany, and Scandinavia, and these will be reflected in the October returns, which are expected to show a marked increase over those for September. The exports during September showed a gratifying increase, the aggregate amounting to 36,821 tons, compared with 35,410 tons in August. Actually the manufactured iron and steel shipments showed a slight decrease, the September total of 26,367 tons being the smallest of any month this year. On the other hand, because of improved business with Scotland, the pig iron shipments advanced from 8382 tons in August to 10,454 tons in September, of which Scotland's share was 4603 tons, the largest tonnage shipped to Scotland during any month of 1931. The foreign shipments of pig iron for the month only reached 3831 tons, compared with 4390 tons in the preceding month.

Iron and Steel Imports.

Although less iron and steel was imported into the river Tees last month than in August, the total of 15,592 tons was greater than in September last year, and considerably more than in 1914. Last year 13,929 tons were imported, and in September, 1914, 1164 tons. During the eleven months, from November last year, 156,704 tons of iron and steel were imported into the river, as compared with 137,008 tons in the corresponding period of 1929–30. Less pig iron was imported last month, as compared with August, the figures being 1675 tons, as against 2294 tons. In September last year 1263 tons were imported. During the eleven months ended September, 25,024 tons were imported, of which 15,634 tons came coastwise.

Heavy Sales of Pig Iron.

Notwithstanding the disturbed political situation, the Cleveland pig iron market retains a very cheerful tone, and business has been very brisk this week. Export business is not easy to arrange, owing to difficulties of exchanges, but home consumers are plainly apprehensive of a rise in prices, and are eager to cover their requirements before the market moves against them. Ironmasters have, however, entered into heavy commitments. It is reported that over 10,000 tons of Cleveland iron have been sold to Scottish consumers, and that this business has been done at a rather higher figure than recent sales. The result is that producers here are taking a firmer stand. They are still willing to sell at the old rates, but are disinclined to enter into forward contracts, as prices are expected to advance. However, quotations remain unchanged this week, No. 1 Cleveland foundry iron being 61s., No. 3 G.M.B. 58s. 6d., No. 4 foundry 57s. 6d., and No. 4 forge 57s.

Hematite Pig Iron.

The rise in the prices of East Coast hematite has not checked the demand, which continues on a heavy scale. Buyers recognise that the advance is fully justified by the cost of production, and they have been placing orders freely. Stocks are heavy, but are now being drawn upon. There are buyers of mixed numbers at 65s., at which figure orders are no longer readily accepted, most sellers asking about 66s. No. 1 quality is at a premium of 6d. per ton.

Iron-making Materials.

There is no market for foreign ore, but 16s. 6d is now a minimum price for best Rubio c.i.f. Tees. Durham blast-furnace coke sellers will not now entertain offers below 15s. 6d. for early delivery of good average qualities, and ask up to 16s. delivered at the works.

Manufactured Iron and Steel.

The improvement in the manufactured iron and steel trade is not so pronounced as in the iron industry, but there is a better demand, and prices are all very firm. Owing to the rise in the cost of sheet bars, galvanised corrugated sheets, 24 gauge, have advanced to £10 per ton, but all other quotations are unaltered.

Blast-furnacemen's Wages.

The ascertained price of No. 3 Cleveland pig iron for the past quarter has been certified at 50s. 0·56d. per ton. If the normal operation of the sliding scale had continued, the ascertainment would have reduced blast-furnacemen's wages by 2 per cent., but, in accordance with an undertaking given by the ironmasters to the men's representatives a few weeks ago, wages will be reduced by 1 per cent. only; that is to say, the bare standard rates will be payable as from October 4th. Neither base rates nor bonus will carry any percentage for the current quarter.

The Coal Trade.

Business in all sections of the Northern coal trade is slowing down, and there is no pronounced pressure experienced for any quality of coal. Continental consumers have apparently contracted for all requirements for the remainder of this year, and for more forward delivery await the trend of events in sterling rates, as well as the development of the home political situation. Some individual collieries are very substantially booked, and are able to hold firmly, but others are eager for further trade for the middle and end of the month. Transactions on a c.i.f. basis are handled cautiously, owing to the uncertainty of the freight position and the relatively small offering of the handy class of tonnage. Recent activity in the steam coal market is not fully maintained, and the undertone tends to become much quieter with prices again in buyers' favour. Best Northumberland steams are sparingly offered, and quoted firm at 14s. 3d., but buyers hold for some slight concessions. Tyne primes are quietly steady at 12s. 9d. to 14s. The Wear prime steam position is quiet, but on the whole steady, although sellers cannot force any appreciation. Best large are offered at 15s. Northumberland steam smalls are in good supply and in slow demand at 8s. 6d., with prime Wear steam small offered at 12s. The Durham gas coal trade has taken a turn for the better. The seasonal demand has begun, and there is more trade for the Mediterranean, where rates of exchange favour buyers. Prices are firm for best qualities at 14s. 6d. and seconds at 13s. 3d. to 13s. 6d. Inquiries for best unscreened bunkers are numerous, and supplies for prompt shipment are rather scarce. Sellers are easily able to obtain 14s. 6d., but for other classes there is a very moderate inquiry, prices remaining about 13s. Coking unscreened and small are in very slow request, and quoted easy at the schedule price of 13s. to 13s. 6d. Foundry cokes are very firm, and the tendency of values is upwards. Current figures are strong at 17s. to 17s. 6d. Gas coke is in steady request, and bookings ahead are substantial. Supplies are offered sparingly, and values are well maintained at 19s. for best kinds. Patent oven coke is easier in tone, and favourite brands are cleared at 17s. Superior foundry coke moves slowly, but is firmly quoted at 18s. to 21s.

SCOTLAND.

(From our own Correspondent.)

Shipbuilding.

The aggregate tonnage launched from Clyde shipyards during September amounted to 620 tons gross, representing two small vessels. For a considerable period work on hand has been steadily diminishing, and the monthly output growing smaller and the latest returns reflect to a certain extent the state of the industry. During this lean period, there have been months when practically nothing has been added to the work on hand, and one month at least which was barren. Last month only one order was reported. For this year to date the aggregate output amounts to forty-five vessels of 135,032 tons, compared with 154 vessels of 411,443 tons in the same period last year. Inquiries for new tonnage are in circulation, but owners naturally are exercising considerable caution in view of the political and financial changes, and new work is likely to be delayed. Many yards are empty, while others have been able to keep their employees fairly well occupied with repair work.

Steel and Iron.

The probable effects of the suspension of the gold standard still provides the main source of interest in the steel and iron industries. The export business is expected

to improve, and better home demands, too, are anticipated, provided that costs, which will be higher, do not neutralise the other advantages. One disadvantage applying particularly to Scotland is that home deposits of ore are practically exhausted, and supplies are dependent almost entirely on imports. Such imports may probably appreciate 2s. 6d. to 3s. per ton, involving an increase of 5s. to 6s. per ton in pig iron. On the other hand, considerable quantities of pig iron are being imported into this district in the form of basic, forge and foundry, and probable increases in the costs of these materials may materially assist the home producer. On the other hand, raw materials in the shape of sheet bars, slabs, and billets, imported from the Continent will cost more. Sheet bars quoted a month ago at £2 17s. 6d. f.o.b. Antwerp, will probably be £3 10s. per ton. It is calculated that foreign semis with the increase added will still be considerably below home prices, also small steel bars, tube strips, and joists. The restrictive effect should be more pronounced, however, in the case of black and galvanised sheets. The inquiry is improving, and it is confidently expected that India, China, and Japan will soon be buying in larger quantities than for some considerable time back. Meanwhile, specifications generally are scarce. Demands for heavy steel are most restricted, and orders for sheets are scarce. Galvanised sheets have been advanced to £11 per ton home and £10 per ton f.o.b. Glasgow for corrugated sheets 24 g. Bar iron and re-rolled steel bars are stagnant. The latter are now quoted £6 home and £5 17s. 6d. per ton export. Demands for local pig iron are still easily met from stocks.

Scrap.

Consumers of scrap have been buying cheaply for some months past, but it is possible that prices may appreciate in view of recent sales to the Continent, and the probable development of such sales. At present cast iron machinery scrap is quoted at 46s., and heavy steel scrap 37s. 6d. per ton.

Coal.

Foreign inquiries have shown a broadening tendency during the past week, and although shippers have found some difficulty in quoting prices, owing to exchange fluctuations and firmer freights, a fair amount of business has been done. Lanarkshire ells have done more business for home delivery and for shipment to the Irish market and splints have a steady outlet. Fifeshire prime steams, too, show improvement. The firmness of treble and double nuts is still the strong feature of the market. In all districts these qualities show further appreciation. Single nuts are inclined to stiffen, but smaller sorts remain easy. Aggregate shipments amounted to 212,328 tons, compared with 213,870 tons in the preceding week, and 202,277 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

So far as the steam coal industry is concerned, there is more evidence of a certain amount of improvement in business than was the case a week ago, though it should be said at once that there is nothing to suggest that the industry is on the verge of a boom, as such statements are only misleading. Employment at a number of collieries is expanding, an increased number of men is being taken on, and there are prospects of work being more regular than has been the case for so long past; but a good deal more business can be dealt with and would, in fact, be welcomed, especially for prompt loading. There is certainly a better inquiry for tonnage, but it should be pointed out that this is partly attributable to orders which have been in hand for some time being brought forward for earlier shipment than was at first intended and partly by new business. There is no question that most of the inquiries which are being received by reason of foreign consumers being able to secure their requirements on better terms owing to this country having gone off the gold standard, are for supplies for delivery ahead, such as during the last two months of this year and the first three months of next year. Many inquiries, of course, are being put forward in order to test prices, and are not, as yet, materialising into actual business; but it is interesting to note that business has been done on a moderate scale in best coals over the whole of next year at 3d. per ton above the minimum price now ruling, and other sales have been effected at the minima. The immediate need of a number of collieries is prompt business, but the loading position this week is a shade better than was the case last week, when, according to the returns of the Great Western Railway Company, shipments at the ports under its control came to the total of 401,890 tons, as compared with 422,760 tons for the preceding week, and with 495,478 tons for the corresponding period of last year. At the end of last week the number of idle tipping appliances was thirty-six, but, as the result of week-end arrivals, the total number at the various ports on Monday was reduced to twenty, and, as the demand lately has been mainly for prompt tonnage, the prospects are that the figures relating to shipments this week will mark an improvement.

G.W.R. Rebates.

The welcome announcement was made last week that rebates allowed by the Great Western Railway Company as from the 1st inst. under the derating provisions of the Local Government Act of 1929, are increased as compared with a year ago. In the case of coal, coke and patent fuel shipped in ordinary wagons, the total amount of rebate has been raised from ¼d. to ½d. per ton, and for that shipped in 20-ton wagons from 1d. to 1½d. per ton, while an additional rebate is that of ½d. per ton in both cases for shipment to Ireland. For tin-plates, black steel sheets and galvanised sheets shipped to foreign destinations, the rebates previously applied to Swansea only, but from October 1st became applicable to all ports and have been raised from 1s. to 1s. 5d. per ton for rail-borne goods, and from 9d. to 1s. per ton for road-borne manufactures. The 7½ per cent. of wharfage rates allowed on coastwise traffic has been increased to 10 per cent. For merchandise not specified in the scale, excluding oil, the rebate of wharfage rates coastwise has been increased from 7½ per cent. to 10 per cent., the same being the case in respect of iron and steel shipped coastwise. The rebate on cranage charges for quayside cranes loading and discharging general traffic is raised from 1d. to 1½d. per ton. The action of the Great Western Railway Company in thus further assisting industry is greatly appreciated.

Tin-plate Trade Rebate.

It is reported that the South Wales Siemens Steel Association has under consideration a scheme under which a rebate will be given off the price of Welsh bars to those sheet and tin-plate consumers who purchase the whole of their requirements from members of the Association.

Steel Tubes.

Merthyr is proceeding as vigorously as possible with plans for developments, notably the setting up of works for the making of steel tubes. The new Industries Advisory Board has discussed the scheme with an expert and has approved of the project. Matters relating to the formation of a limited liability company have been referred to its sub-committee. It is suggested that £50,000 should be raised for the building and equipment of the works, which might afterwards be enlarged by the subscription of new capital.

Pitwood Contracts.

No settlement has been come to regarding the question at issue between importers of pitwood and French exporters of this commodity, although considerable indignation exists at the attitude taken up by the latter, who, it will be recalled, have demanded that, notwithstanding their contractual obligations, they should be paid on the basis of the gold standard. French exporters are not now, however, declining to load steamers, but are doing so "under protest." It is reported that the exporters have suggested that the point at issue should be submitted to arbitration by an international body, but the local pitwood importers' association has not agreed to this course.

Boilermakers Stop Work.

It is a matter for regret that just at the present time, when trade is expanding, boilermakers throughout this area should refuse to work. They declined to present themselves for work on Thursday last week, on which day the reduced rates of pay put into operation by the Shipbuilders' Employers' Federation came into force. In this district the reductions in pay are to operate in two instalments, viz., from the first full week in October and from the first full week in January. All the other grades of workmen in the ship-repairing industry put in an appearance at work except the boilermakers, and this, of course, means that vessels which come along with damage that requires to be repaired cannot be dealt with. The inevitable result is that vessels are being diverted to the Continent, but the loss does not end there, as it means that owners will not send their steamers to this Channel to load cargoes so that employment at the docks generally suffers, and business in stores, &c., is sacrificed.

Iron and Steel Notes.

Five furnaces were restarted at the Llanelly Steel Company's works on Monday, with the result that there are altogether about 400 men in employment. The bar mill was restarted last week. On Thursday last week the South Wales Siemens Steel Association decided to advance the price of tin-plate bars from £4 12s. 6d. to £5. This is stated to be due not so much to increased demand as to the fact that the prices of raw material have gone up. The "big mill" at the Dowlais (Merthyr) Iron and Steel Works was reopened on Monday, after being idle for two months, for the purpose of producing colliery arches. It is expected that work will be continued for two or three weeks. It is also reported that the British (Guest, Keen, Baldwins) Iron and Steel Company is "blowing in" an additional furnace at the end of this week at its Margam Works. This furnace is capable of producing about 2000 tons of pig iron per week.

Coalfield Items.

The Werntaw pits have been sold by Mr. Hedley Garrett (of R. H. March, Son and Co.), liquidator of the Meiros Collieries, Ltd., the purchasers being Mr. Rees Rees, formerly general manager of North's Navigation Collieries, and Mr. H. Glyn Roberts. A new company is to be formed under the style of Meiros Collieries (1931), Ltd. Work was resumed at the pits on Monday last. It was expected that notices on behalf of 800 workmen would be tendered to the Bedwas Colliery Company on Monday, but it is understood that, after a conference between the lodge officials and representatives of the South Wales Miners' Federation, it was agreed to withhold the notices. The trouble between the men and the employers relates to the question of re-employment and seniority. It is announced that Mr. B. E. Brown, of Deloitte, Plender, Griffiths and Co., has been appointed receiver and manager for Locket's Merthyr Collieries (1894), Ltd. Work was suspended at the company's pits last week-end, but hopes are entertained that a resumption will be made towards the end of this week.

Current Business.

The tone of the steam coal market is a little brighter, but actual business for early shipment is restricted, and there is no doubt that the instability of foreign exchanges is responsible for operations not expanding more readily. Dry qualities of coal are relatively steadier than other grades, but prices almost all round remain at the minima. Coke and patent fuel are quiet, and the demand for pitwood is by no means active, prices of the latter being about 26s. to 26s. 6d.

CONTRACTS.

DANIEL ADAMSON AND CO., Ltd., of Dukinfield, have obtained an order for a super-Lancashire boiler plant from the Hull Fish Meal and Oil Company, of Hull.

THE WESTINGHOUSE BRAKE AND SAXBY SIGNAL COMPANY, Ltd., has received from the Ashington Coal Company, Ltd., an order for the supply of six sets of tippler rams and skotch blocks arranged to work fully automatic or under hand control, twelve sets of tub retarders, twenty point controls.

PETER BROTHERHOOD, Ltd., Peterborough, has received orders for one 300 B.H.P. six-cylinder Brotherhood-Ricardo high-speed engine for oil well drilling equipment in Burma, and for two 100 B.H.P. two-cylinder engines of the same type, one with Laurence-Scott dynamo and one with Brotherhood dynamometer, for U.S.S.R., through Arcos, Ltd.

EDGAR ALLEN AND CO., Ltd., Imperial Steel Works, Sheffield, has received a contract from Cement Industries, Ltd., for the supply and erection of a complete Portland cement plant, which will be situated at Asheham, near Lewes, Sussex. The factory will concentrate on the production of rapid-hardening cement. In addition, a Schulthess lime hydrating plant is being installed in connection with the existing lime plant which is being enlarged.

DAVY BROTHERS, Ltd., of Park Ironworks, Sheffield, have just concluded important contracts with Arcos, Ltd., the representatives in this country of the Russian Government. In addition to the reconstruction of a 6000-tons forging press, they are at present building one 10-ton, three 5-ton and two 3-ton forging manipulators, for new plants now being erected in Russia. Further orders for the same destination include a number of "Davy" patent turning gears, for rotating forgings whilst they are being forged under presses, as well as a 5-ton charging machine of the "Alliance" type.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

CHARLES CHURCHILL AND CO., Ltd., have now moved to new premises at 27–34, Walnut Tree Walk, Kennington, London, S.E. 11.

HARLAND AND WOLFF, Ltd., inform us that their London address has been changed from 1A, Cockspur-street, to 9, Whitehall, S.W. 1, and that their new telephone number is Whitehall 6831.

DAVEY, PAXMAN AND CO., Ltd., of Colchester, have received from Drake and Gorham, Ltd., an order for five totally enclosed heavy duty oil engines for the Prudential Assurance Company, Ltd., London. Each engine is of six cylinders and will be direct coupled to 200-kW generators.

THE STANDARD PISTON RING AND ENGINEERING COMPANY, Ltd., informs us, with deep regret, that its technical representative, Mr. L. J. Pardon, who was very well known amongst engineers of all classes and shipping companies, met with a motor accident at some cross roads outside Walsall, and died at Walsall Hospital on Monday, October 5th.

A. RANSOME AND CO., Ltd., are informed by Mr. H. Tansley Witt, F.C.A., recently appointed receiver and manager of A. Ransome and Co., Ltd., of Newark-on-Trent, that he is carrying on the business, and no effort will be spared to maintain the high reputation as to quality and efficiency which the company has enjoyed for more than seventy-six years. Spare parts, replacements, and tools will be supplied as usual.

AGRICULTURAL AND GENERAL ENGINEERS, Ltd., Aldwych House, London, announce that in continuation of their policy of co-ordinating the activities of their subsidiary companies, the manufacture of the products of their subsidiary company, Barford and Perkins, Ltd., will, as from January 1st next, be conducted at Rochester in conjunction with those of Aveling and Porter, Ltd. The effect of this closer association will be to make the Rochester works the largest producers of steam, oil, and motor rollers in the world.

CROMPTON PARKINSON, Ltd., has made arrangements by which electric supply undertakings, electrical contractors or engineering resellers can supply to their clients electric motors and other electrical equipment on hire-purchase terms. The new scheme has been reduced to the simplest possible transaction for the reseller concerned. Quotations for the electrical equipment required may be obtained either from any of the company's branch offices or from current price lists, and a fixed interest charge added which is quoted in a schedule available on request.

ENGINEERING GOLFING SOCIETY.—The autumn meeting of the Society was held at Stoke Poges on Wednesday, September 30th. In the morning there was an eighteen-hole medal round, and the "Hele-Shaw" Scratch Challenge Cup and Memento were won by F. I. Sutherland Gill, with a score of 76. The handicap resulted as follows:—First Division (handicaps of 10 and under): the "F. J. Walker" Challenge Cup and Memento, R. B. Grey, 82—7=75; second prize, J. Townley, 83—7=76. Second Division (handicaps of 11 and over): the "P. B. Brown" Challenge Cup and Memento, Walter Phillips, 89—11=78; second prize, L. Trewby, 91—12=79. Prizes for the best first and second nine holes were taken by P. V. Hunter and R. E. Dewra respectively. In the afternoon there was an eighteen-hole round, foursomes against bogey, when the "Hadfield" Challenge Cups and Mementoes were won by F. I. Sutherland Gill and W. H. Shortt, 2 up. The second prizes going to, triple tie at 1 down, D. S. Allom and J. B. Marr, C. R. D. Pritchett and E. S. New, S. Groom and L. Trewby. There were forty-two competitors.

THE INSTITUTION OF MECHANICAL ENGINEERS.—The opening meeting of the winter session of the North-Western Branch of the Institution of Mechanical Engineers was held at the Engineers' Club, Manchester, on October 1st, when Professor R. V. Southwell, M.A., F.R.S., Professor of Engineering Science of Oxford University, delivered a lecture illustrated by slides and a cinematograph film entitled "Some Problems in Aerodynamic Research." There was a very large attendance of members and visitors. In introducing the lecturer, Mr. H. L. Guy, chairman, said that as a member of the Research Committee Professor Southwell had played his part in the recent British achievement in the Schneider Trophy. In his introductory remarks Professor Southwell said that the subject of the lecture was really "Model Work Related to the Aeroplane," and it had less to do with the aeroplane than with the air which surrounded it. If air had been a visible gas, flying would have progressed more quickly. He then went on to describe the tests which had been conducted in wind tunnels at Cambridge, with the aid of sectional drawings and photographic slides. Some idea of the importance of the tests may be gathered from the fact that fans of some 400 horse-power were required to deal with the air at a pressure of 25 atmospheres. The cinematograph films showed the remarkable eddy effects and drag which accompany the passage of the planes through the surrounding medium. At the conclusion of the lecture a vote of thanks, proposed by Professor Gibson and seconded by Dr. Morley, was carried with acclamation.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
(1) Native	16/- to 20/6
(1) Spanish	16/- to 18/-
N.E. Coast—	
Native	18/- to 21/-
Foreign (c.i.f.)	16/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	3 8 6	—
No. 1 Foundry	3 12 0	—
No. 3 Foundry	3 9 6	—
N.E. Coast—		
Hematite Mixed Nos.	3 6 0	3 6 0
No. 1	3 6 6	3 6 6
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
Midlands—		
(c) Staffs.—	(*Delivered to Station*).	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 1 0	—
„ „ Foundry	3 6 0	—
(c) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 6	—
(c) Derbyshire—		
No. 3 Foundry	3 6 0	—
Forge	3 1 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. Coast—		
N. Lancs and Cum.—		
Hematite Mixed Nos.	3 15 6 (*a*) 4 0 6 (*b*) 4 5 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	10 5 0	9 10 0
Best	—	—
N.E. Coast—		
Iron Rivets	11 5 0	—
Common Bars	10 10 0	—
Best Bars	11 0 0	—
Double Best Bars	11 10 0	—
Treble Best Bars	12 0 0	—
Lancs.—		
Crown Bars	9 15 0	—
Second Quality Bars	8 5 0	—
Hoops	12 0 0	—
S. Yorks.—		
Crown Bars	9 15 0	—
Best Bars	10 15 0	—
Hoops	12 0 0	—
Midlands—		
Crown Bars	9 5 0 to 10 7 6	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 7 6 to 9 0 0	—
Gas Tube Strip	10 10 0 to 10 12 6	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates (Marine)	10 10 0	10 10 0
„ „ (Land)	10 10 0	10 0 0
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	7 10 0	7 10 0
Sheets (Gal. Cor. 24 B.G.)	11 0 0	10 0 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
Manchester—		
Bars (Round)	9 7 6	—
„ (Small Round)	7 0 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	8 15 0	—
Sheffield—		
Siemens Acid Billets	9 2 6 (basis)	—
Hard Basic	8 2 6 and 8 12 6	—
Intermediate Basic	6 12 6 and 7 2 6	—
Soft Basic	6 0 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	7 10 0	—
Midlands—		
Small Rolled Bars	6 10 0 to 7 5 0	—
Billets and Sheet Bars	5 5 0 to 5 10 0	—
Galv. Sheets, f.o.b. L'pool	9 15 0 to 10 0 0	—
(2) Staffordshire Hoops	9 10 0	—
(*d*) Angles	8 7 6	—
(*d*) Joists	8 15 0	—
(*d*) Tees	9 7 6	—
(*d*) Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 0 0	—

NON-FERROUS METALS.

Swansea—		
Tin-plates, I.C., 20 by 14	f.o.b.	14/- to 14/6
Block Tin (cash)		124 10 0
„ (three months)		128 12 6
Copper (cash)		33 2 6
„ (three months)		34 2 6
Spanish Lead (cash)		12 15 0
„ „ (three months)		13 0 0
Spelter (cash)		12 0 0
„ (three months)		12 13 9
Manchester—		
Copper, Best Selected Ingots		41 0 0
„ Electrolytic		42 0 0
„ Strong Sheets		75 0 0
„ Tubes (Basis Price), lb.		0 0 10½
Brass Tubes (Basis Price), lb.		0 0 9½
„ Condenser, lb.		0 1 0
Lead, English		14 10 0
„ Foreign		13 2 6
Spelter		12 17 6
Aluminium (per ton—raw ingot)	£85	

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	2/4 per lb.	
Ferro Tungsten	2/- per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£25 0 0	7/-
„ „ 6 p.c. to 8 p.c.	£24 0 0	7/-
„ „ 8 p.c. to 10 p.c.	£22 10 0	6/6
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£35 0 0	10/-
„ „ „ 1 p.c. carbon	£39 0 0	12/-
„ „ „ 0·70 p.c. carbon	£41 0 0	13/-
„ „ „ carbon free	11d. per lb.	
Metallic Chromium	3/1 per lb.	
Ferro Manganese (per ton)	£11 0 0 for home	
„ „ „	£11 10 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£10 10 to £12 scale 5/- per unit	
„ „ 75 p.c.	£16 to £17 scale 7/- per unit	
„ Vanadium	12/9 per lb.	
„ Molybdenum	4/2 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£210	
Ferro Cobalt	8/6 per lb.	

FUELS.

SCOTLAND.

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	14/-
„ „ Ell	14/9
„ „ Splint	14/- to 15/9
„ „ Trebles	13/6
„ „ Doubles	13/-
„ „ Singles	10/-
Ayrshire—	
(f.o.b. Ports)—Steam	13/6
„ „ Jewel	17/-
„ „ Trebles	14/6
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	12/6 to 14/-
Screened Navigation	17/-
Trebles	15/- to 16/-
Doubles	13/6 to 14/-
Singles	10/6
Lothians—	
(f.o.b. Leith)—Best Steam	12/- to 12/6
Secondary Steam	11/6
Trebles	15/- to 15/6
Doubles	13/6 to 14/-
Singles	10/-

ENGLAND.

	Inland.
(8) N.W. Coast—	
Steams	21/-
Household	30/- to 51/-
Coke	20/- to 20/6
Northumberland—	
Best Steams	14/- to 14/3
Second Steams	12/- to 12/3
Steam Smalls	8/6
Unscreened	12/6 to 13/-
Household	27/- to 39/-
Durham—	
Best Gas	14/6
Second	13/3 to 13/6
Household	25/- to 37/-
Foundry Coke	24/-
Sheffield—	
Best Hand-picked Branch	24/6 to 25/6 —
South Yorkshire Best	23/6 to 24/6 —
Derbyshire Best Bright House	21/- to 22/- —
Best House Coal	21/6 to 22/6 —
Screened House Coal	19/- to 20/- —
Best Screened Nuts	18/- to 19/- —
Small Screened Nuts	16/6 to 17/6 —
Yorkshire Hards	17/- to 18/6 —
Derbyshire Hards	17/- to 18/6 —
Rough Slacks	9/6 to 10/6 —
Nutty Slacks	7/6 to 8/6 —
Smalls	5/6 to 6/6 —
Blast-furnace Coke (Inland)	10/- on rail at ovens
Furnace and Foundry Coke (Export), f.o.b., 14/- to 15/-	

(9) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	19/6
Second Smokeless Large	18/9 to 19/6
Best Dry Large	18/6 to 18/9
Ordinary Dry Large	17/9 to 18/3
Best Black Vein Large	18/3 to 18/6
Western Valley Large	17/9 to 18/-
Best Eastern Valley Large	17/7½ to 17/9
Ordinary Eastern Valley Large	17/3 to 17/6
Best Steam Smalls	13/- to 13/6
Ordinary Smalls	11/- to 13/-
Washed Nuts	18/- to 21/-
No. 3 Rhondda Large	19/9 to 20/-
„ „ Smalls	15/- to 16/-
No. 2 „ Large	17/- to 17/3
„ „ Through	15/6 to 16/-
„ „ Smalls	14/- to 14/3
Foundry Coke (Export)	22/- to 36/6
Furnace Coke (Export)	16/6 to 17/6
Patent Fuel	19/- to 19/9
Pitwood (ex ship)	26/- to 26/6
Swansea—	
Anthracite Coals:	
Best Big Vein Large	35/- to 37/6
Seconds	27/- to 31/6
Red Vein	22/6 to 27/6
Machine-made Cobbles	41/6 to 45/-
Nuts	40/- to 46/-
Beans	24/9 to 28/3
Peas	21/- to 22/-
Breaker Duff	8/6 to 9/6
Rubbly Culm	8/6 to 9/-
Steam Coals:	
Large	20/- to 20/6
Seconds	18/- to 20/-
Smalls	11/6 to 13/-
Cargo Through	16/- to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate: Joists (minimum), 22/6; Ordinary Ship, Bridge, and Tank Plates and Sections, 15/- if home consumers confine purchases from associated British Steel Makers. (*e*) Delivered Black Country Stations.

French Engineering Notes.

(From our own Correspondent in Paris.)

Production Costs.

MANUFACTURERS find that their situation is becoming steadily worse since some countries were obliged to follow the lead of Great Britain and abandon the gold standard, and all of them have had to take steps to adapt themselves to the new condition of things. There is a lowering of wages and an increase of import duties. In Germany decrees have been promulgated reducing wages on condition that manufacturers take on a correspondingly increased number of men. The temporary reductions of wages are not large, but makers have been relieved of some social and other charges. In Belgium further reductions are being resisted by the men. While production costs are being lowered abroad, there is little prospect of their coming down in this country, where living costs remain at a relatively high level. The difficulties over the forthcoming Budget are not calculated to improve matters, in view of probable economies in expenditure on public works and the fear that further burdens may have to be imposed indirectly on industry. The disparity in production costs has for the moment upset the normal conditions of competition.

Agricultural Tractors.

The trials of agricultural tractors, which were held last week near Versailles, came within the scope of the national fuel propaganda, and it was hoped that some practical results would be shown of the work accomplished in substituting home-produced fuels for imported oils. They were carried out on a large scale with tractors of different nationalities, principally French, German, and American, but there was nothing new in the machines, amongst which single-cylinder horizontal hot-bulb engines, built into the body of the tractor, represented the latest development of economical tractors for agricultural uses. There was a special exhibit of industrial engines supposed to be running on national fuels, but, except for wood suction gas plants, they were all using mineral oils, while various devices were shown for vaporising heavy oils to be used in petrol engines. These devices represent the only practical advance that has been made towards the solution of the motor fuel problem, apart from recent improvements in solid-injection engines. They are usually based upon the supposed catalytic effect of metals upon the hot oils and a cracking of the light particles, and while good results have been obtained with them in trials, they have failed to receive any extensive practical application. In one apparatus a thick steel plate has a central hollow boss with holes. The plate is heated by the exhaust and gas oil is injected through the perforated boss, and is mixed with air. The mixture passes round a series of circular baffles, where it is vaporised, and the gas falls in temperature at the exterior, where it enters the induction pipe. Another device consists in passing the gas oil through a number of small tubes heated by the exhaust. There is nothing about these devices that gives much promise, but they show the trend of research, and, notwithstanding the failures of all attempts to use heavy oils satisfactorily in petrol engines, it is still hoped by many that this step may eventually provide one solution of the problem. So far as agricultural tractors are concerned, the future seems to lie entirely with the solid injection engine. That fact, however, suggests a possible increase of fuel price with the growing consumption, and the French idea, therefore, is to evolve types of light engines that will run satisfactorily on all kinds of liquid fuels.

Warm Water Energy.

Monsieur Georges Claude held a conference at the Sorbonne last week on the "final step towards the realisation of the Claude-Boucherot system of power generation from seas," and described what had been done at Cuba. While he claimed that he had demonstrated the practical character of his method, the experiment, he declared, had shown him how to overcome the technical difficulties. It now remained to put down a plant in the light of that experience. Afterwards, Monsieur Claude described to the Société des Ingénieurs Civils the general lines of a plant for the production of an amount of energy that would leave 40,000 kW for distribution. The extraction of air would take 3000 kW, the raising of the water 8000 kW, and the pumping of the warm water back to the sea 2600 kW. The system of corrugated pipe, 2 m. in diameter, employed at Cuba will, he explained, have to be abandoned, and he proposes to use a pipe 10 m. in diameter, built up of rings of 9 mm. steel in the form of short truncated cones and welded together to form a serrated pipe. The pipe will be closed at the ends and floated out, and, when connected with the land end, water will be admitted to sink it. Monsieur Claude did not explain how the blank end will be removed from the pipe at the bottom of the sea. The risk of corrosion will be avoided by the use of suitable alloys. Monsieur Claude, however, affirms that there is little corrosion at the bottom of the sea, and states that sheet iron pipes which he has raised after they had been immersed at great depths for several months showed no signs of corrosion. The construction and laying of the pipe will account for about one-half of the total cost of the installation.

Ship Canal.

The proposal to construct a ship canal across the north of France from Dunkirk to the Rhine has again been revived by the Chambers of Commerce of the towns interested in the scheme. The plans have long been prepared, and some work has already been done with the widening and deepening of existing canals, but the carrying out of the general scheme has been delayed by financial difficulties. Dunkirk is urging the immediate execution of an undertaking which is necessary for its traffic with the northern industrial districts, and also for diverting traffic from Alsace and Central Europe, which at present goes to Antwerp and Rotterdam. The object is to make a canal 50 m. wide and from 7 m. to 8 m. deep for seagoing boats of 1000 tons, and for an accelerated service of big barges. The canal will be 51 miles in length, and will extend to Roubaix, Tourcoing, and Lille, with basins and wharves in the industrial centres, and it will be ultimately carried to the Rhine.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

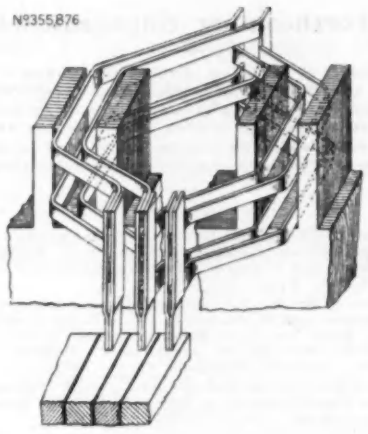
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

DYNAMOS AND MOTORS.

355,876. June 25th, 1930.—COMMUTATING DYNAMO-ELECTRIC MACHINES, The English Electric Company, Ltd., of Queen's House, 28, Kingsway, London, W.C. 2, and James Cooper Wilson, of Siemens Works, Stafford.

The object of this invention is to reduce the self-induction of the armature coils when undergoing commutation. It is known that a coil laid in the upper part of an armature slot of the open type has a lower self induction than a similar coil occupying the whole depth of the slot, and if a coil placed in the upper part is connected in parallel to a coil laid in the lower part, it is obvious that the self-induction of the combination cannot be greater than

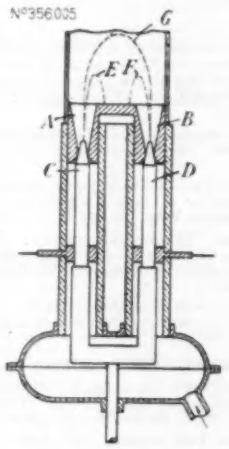


that of the upper coil alone. In the invention this idea is applied, and accordingly each armature coil is divided into two parallel branches, one branch being a coil, of which each side lies in the upper part of a slot, and the other a coil, of which each side lies in the lower part of a slot. Each side of one branch of a coil may lie in the same slot as the corresponding side of the other branch of the same coil. If the number of armature slots is divisible by the number of poles of the machine, however, corresponding sides may be in different slots, so that the upper branch of a coil spans more than a pole pitch and the lower parallel branch spans less than a pole pitch.—*September 3rd*, 1931.

SWITCHGEAR.

356,005. October 13th, 1930.—ELECTRIC SWITCHES WITH ARC EXTINCTION BY COMPRESSED GAS, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

This invention relates to electrical switches with arc extinction by compressed gas in which, in order to interrupt high voltages, a multiple break in the circuit is preferably arranged for. On moving the switch rod downward two arcs are formed at the nozzles A and B and pass from the contact pin C or D to the

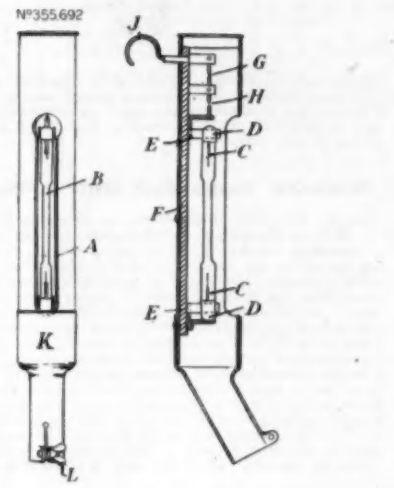


two nozzles respectively, and are quickly blown upwards by a jet of compressed gas. As soon as the two arcs produced on breaking the circuit have assumed the shape shown in dotted lines E and F, the joint arc shown by the dotted line G is formed from them and is quickly blown upwards under the action of the compressed gas jets in the blow-out chamber and is extinguished. The formation of the joint arc results in a considerable improvement in the blow-out effect.—*September 3rd*, 1931.

MEASURING AND TESTING INSTRUMENTS.

355,692. February 24th, 1930.—ELECTRIC POTENTIAL INDICATING DEVICES, the Edison Swan Electric Company, Ltd., of 123–5, Queen Victoria-street, London, E.C. 4; Ernest Greetham, of 27, Louis-street, Hull, York, and George Frederick Shotter, of 14, The Ridgeway, Friern Barnet, London, N. 11.

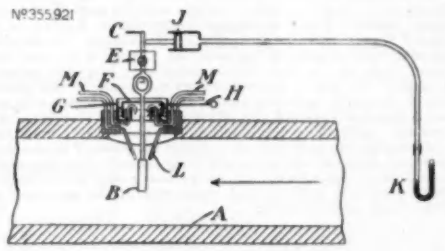
This specification describes a simple device which may be connected either temporarily or permanently to an electric circuit to indicate the presence of potential. The device is particularly, but not exclusively, designed for use on high-tension power transmission systems. The indicator comprises a casing of insulating material having a window A through which the glow emanating from a discharge tube B may be viewed. The discharge tube comprises an elongated glass receptacle, preferably filled with neon, at a pressure of a few millimetres of mercury, and having separated electrodes C connected to end caps D. The tube is supported by means of spring contact clips E, which are attached to an insulating strip F, secured to the interior wall of the casing. The upper contact clip E is connected through spark gaps G and H, formed between needle-like electrodes to a contact clip J, projecting from the casing and adapted to be brought near to, or into contact with, the circuit, the potential on which is to be indicated. At the lower end the casing is provided with a hollow metal support K, the upper end of which surrounds the lower end of the casing, while the lower end is hollow and is adapted to



be engaged by an insulating handle, which is inserted and clamped therein by a wing nut L. The cap K is connected to the lower spring contact E, and is thus in connection with the lower electrode C of the discharge tube. The cap K provides a capacitative coupling to earth with the lower terminal of the discharge tube. The insulating handle may be of any suitable length, and the indicator is raised so as to put the contact J into connection with the circuit, the potential on which is to be indicated. Owing to the capacitative coupling provided by the cap K, on connection to a "live" high-tension circuit a current passes across the spark gaps through the discharge tube, and by way of the capacitative coupling to earth, and a glow occurs in the discharge tube indicating the presence of a potential on the circuit. The operator is adequately protected by the insulating handle, which may be retained in the cap K by screwing up the wing nut L.—*August 24th*, 1931.

355,921. August 6th, 1930.—FLUID-METERING DEVICES, The National Federation of Iron and Steel Manufacturers (Corporate Organisation), Ltd., and Lewis Reeve, both of Caxton House (East), Tothill-street, Westminster, S.W. 1.

This invention relates to fluid-metering devices, and has for its object to provide a simple and efficient means for measuring particularly the flow of gases, and, especially, dirty gases, through pipes. A is a conduit or pipe through which the fluid to be measured passes in the direction of the arrow. B is a diaphragm carried by a vertical lever C pivoted on knife edges and carrying at its upper arm an adjustable weight E. The lever C passes through the inverted, bell-like member F of an oil seal G fixed in an opening in the side of the conduit A. The arrangement is similar to that of a gasometer, and allows of movement of the diaphragm B without escape of gas from the conduit. This



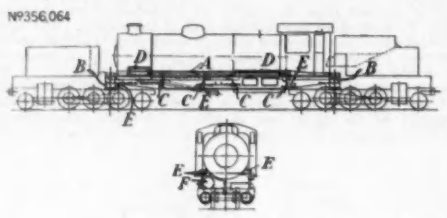
liquid seal comprises an annular member G, containing oil, into which depends the bell-like member F, which is fixed on the lever C. In order to permit of the removal of the diaphragm B without any serious escape of gas, a sliding shutter H is provided. The upper end of the lever C above the knife edges operates against a piston or diaphragm J situated at right angles to it in a cylinder, the cylinder being coupled by a pipe of small bore to a pressure gauge K. The movement of the piston or diaphragm J, and consequently the reading of the pressure gauge, will be in accordance with the movement and position of the diaphragm plate B, and the movement and position will, of course, depend upon the flow of gas in the pipe A. In order to obviate the necessity for too frequent removal of the diaphragm plate B for cleaning, steam jets L are arranged in such a manner that steam can be made to impinge upon the plate. Additional jet pipes M are shown for cleaning the inner passage of the oil seal.—*September 3rd*, 1931.

LOCOMOTIVES.

356,064. December 19th, 1930.—ARTICULATED LOCOMOTIVES, Beyer, Peacock and Co., Ltd., of Gorton, Manchester; and Samuel Jackson, of "Brevik," 260, Bramhall-lane, Stockport, Cheshire.

The usual form of locomotive construction, this specification explains, necessitates the use of a large number of riveted or bolted joints, which tend to work loose in service. The invention proposes to obviate this trouble by eliminating the riveted or bolted joints as far as practicable and comprises a complete framework, embodying side and cross members with pivot centres made in one casting, preferably of steel or an alloy giving the desired strength. If desired, the framework may be made of more than one casting, and it may embody steam or exhaust pipes or water or other pipes, or reservoirs, and the side and other members may be of any desired section and may have boiler-carrying bearers or brackets and other brackets cast

integral with the framework. The side platforms and driver's platform may be cast with the framework, or made separately of plates, and, in certain cases, auxiliary platework may be used. The illustration shows an articulated locomotive with the boiler unit having a framework A made of a single

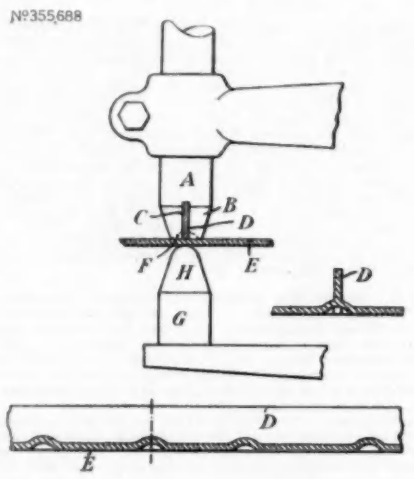


casting and comprising pivot centres B, cross stays C, boiler and fire-box supports D, steam or water pipes E, and air reservoirs F. The provision of other brackets, pipes, and other desired members cast integral with the framework as desired will be obvious.—*September 3rd*, 1931.

MACHINE TOOLS AND SHOP APPLIANCES.

355,688. May 26th, 1930.—Welding of Metal Sheets, Leslie William Blanchard, of "Englefield," Pinner, Middlesex.

According to this invention the electrodes of a spot welding apparatus are formed in such a manner as to hold one of the elements which are to be united and to displace sufficient metal from the second element to ensure a secure joint being made. In the arrangement illustrated the upper electrode A of a spot welding apparatus is of the usual construction, its point B being in the form of an inverted truncated cone. Through this cone there is a vertical slot C of width and depth to correspond with the dimensions of a metallic strip D which is to be welded to a plate or sheet E, the lower end or point of the electrode A having a cup or recess F formed therein. The bottom electrode G is of similar form to the top electrode, but is without the slot and its tip is rounded as shown at H so as to be capable of fitting into the recess F formed in the tip of the upper electrode. Assuming that one edge of the strip of metal D is to be welded

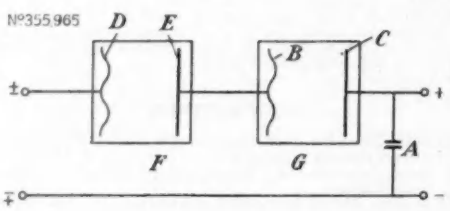


to the face of a sheet of metal E, the strip is passed through the slot C in the top electrode and the plate or sheet E to which it is to be attached is caused to rest upon the bottom electrode. In this case the strip D is held vertically and the plate E in a horizontal position if a right-angled connection is desired or the plate E may be tilted to any other required angle. On bringing the electrodes A and G together, the closing of the electrical circuit heats up the metal in the usual way, and when pressure is applied the lower electrode forces the metal of the plate E into the recess F in the top electrode, thus forcing some of such metal displaced around the adjacent edges of the strip D to form the weld. The displacement effected by the lower electrode moulds the weld into the shape of the recess F in the upper electrode, the metal of the plate E being thereby forced upwards to a slight extent at each side of the lower edge of the strip D, which results in rigid angular connection of the strip and the plate.—*August 26th*, 1931.

MISCELLANEOUS.

355,965. September 11th, 1930.—Electrolytic Rectifiers and Circuits, Henry James Parker, of 105, Elmers End-road, Beckenham, Kent; Eric Arthur Rea-Palmer, of 18, Eldon Park, South Norwood, Surrey; Arthur Gilholme Spence, of 103, Elmers End-road, Beckenham, Kent.

The object of the invention is to remove some of the disadvantages of electrolytic rectifiers, and with that end in view it embodies the use of an electrolyte, which is composed of an aqueous solution of pyroborate of sodium and bicarbonate of potassium. The invention also covers the circuit connection of such an electrolytic cell. In the



preferred form of carrying the invention into effect, two cells, of the known type, but having an electrolyte composed of an aqueous solution of pyroborate of sodium and bicarbonate of potassium, are connected in series and a condenser, having a minimum capacity of 1 (one) microfarad, arranged between the output leads substantially as shown at A. The arrangement enables the rectifier to be worked directly on high voltage, on extremely high resistance and low amperage loads, and with a considerable increase in the efficiency of rectification, and extension of working life of the cells as has been demonstrated by actual tests carried out on currents up to 500 volts. As an example of the electrolyte the following composition is given:—Pyroborate of sodium, 8 oz.; bicarbonate of potassium, 8 oz.; distilled water, 1 (one) gallon. The action produced by connecting two cells and a condenser in the manner described is that the first cell rectifies the alternating impulses into an A.C. having approximately 95 per cent. positive and 5 per cent. negative direction, while the second cell completely damps out the remaining negative current. The available positive current being of a pulsating description is accumulated at the condenser, from which a smooth supply of D.C. can be drawn, and any slight negative current that may pass the rectifying cells is automatically by-passed to the return circuit. E and C indicate two aluminium or tantalum electrodes; while D and B show two lead or other suitable electrodes. The cells are marked F and G. It will be seen that one of the A.C. mains is taken to the lead electrode D in cell F. The current flows through the electrolyte to the aluminium electrode E in the same cell, and is then partially rectified. The aluminium electrode E is connected to the lead electrode B in cell G, and rectified current flows to the aluminium electrode in that cell. The condenser A is connected between the aluminium electrode C in cell G, and the return side of the A.C. circuit. The D.C. output is then taken from the terminals of the condenser A. It has been discovered that:—(1) Such rectifiers are capable of dealing with currents at pressures up to a voltage of 1-500 volts in an efficient manner, and that they (2) are eminently suited for use in wireless battery eliminators.—*September 3rd*, 1931.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME and PLACE at which the meeting is to be held should be clearly stated.

TO-DAY.

Chemical Engineering Group.—Chemical Society's Rooms, Burlington House, Piccadilly, London, W. 1. Paper, "The Manufacture and Testing of Asphalt Paving Material," by Mr. D. M. Wilson. 8 p.m.

Institute of Metals: Sheffield Local Section.—Conjoint meeting with the Sheffield Society of Engineers and Metallurgists, in the Non-ferrous Section of Applied Science Department of the University, St. George's-square, Sheffield. "Gases in Metals," by Dr. W. Rosenhain, F.R.S. 7.30 p.m.

Institution of Municipal and County Engineers.—Eastern District meeting at Barking. Assemble Town Hall, Barking, 11 a.m.

Institution of Production Engineers: London Section.—In the Council Room of the Society of Manufacturers and Traders, 83, Pall Mall, S.W. 1. Annual general meeting. 7 p.m. "Distribution and Production," by Mr. J. G. Young. 7.30 p.m.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. "Office Engineering," by Mr. Edwin D. Gill. 7.30 p.m.

Junior Institution of Engineers: North-Eastern Section.—County Hotel, Newcastle-on-Tyne. Annual general meeting. "Roller Bearings, with Particular Reference to Taper Roller Bearings," by Mr. G. H. Ayres. 7.15 p.m.

Manchester Association of Engineers.—In the Engineers' Club, Albert-square, Manchester. Presidential address by Mr. C. E. Stromeyer. Presentation of the Constantine and Butterworth Gold Medals. Smoking concert. 7.15 p.m.

MONDAY, OCTOBER 12TH.

Institute of Metals: Scottish Local Section.—In the Rooms of the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. "Some Random Reflections on Industrial Problems and Economics," by Mr. L. Short. 7.30 p.m.

Institute of Transport.—At the Institution of Electrical Engineers, Victoria Embankment, W.C. 2. Presidential address by Mr. Frank Pick. 5.30 p.m.

TUESDAY, OCTOBER 13TH.

Institute of Marine Engineers.—The Minories, E.C. 3. "Safety Valves," by Mr. Donald MacNicoll. 6 p.m.

Institute of Metals: North-East Coast Local Section.—In the Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-on-Tyne. Chairman's address, by Mr. J. W. Craggs. 7.30 p.m.

Institute of Metals: Swansea Local Section.—At the Y.M.C.A., Swansea. Chairman's address, by Mr. A. M. Kempson. 6.15 p.m.

Institution of Petroleum Technologists.—At the House of the Royal Society of Arts, John-street, Adelphi, W.C. 2. "Sweating of Paraffin Wax," by Mr. H. L. Allen. 5.30 p.m.

Institution of Welding Engineers: North-Western Branch.—In the College of Technology, Sackville-street, Manchester. "Applications of Resistance Welding," by Mr. L. B. Wilson. 7.30 p.m.

Sheffield Metallurgical Association.—198, West-street, Sheffield. "Salving German Battleships at Scapa Flow," by Mr. E. F. Cox. 7.30 p.m.

WEDNESDAY, OCTOBER 14TH.

Institution of Civil Engineers: Manchester and District Association.—36, George-street, Manchester. Chairman's address by Mr. E. H. Morris. 6.45 p.m.

Institution of Engineering Inspection.—In the Rooms of the Royal Society of Arts, John-street, Adelphi, London, W.C. 2. "Some Applications of Condensers to Electric Power Circuits," by Mr. P. R. Coursey. 5.30 p.m.

Institution of Engineers-in-Charge.—St. Bride Institute, Bride-lane, Fleet-street, E.C. 4. Presidential address by Mr. William Reavell, "Further Engineering Notes on a World Tour." 7.30 p.m.

Newcomen Society.—Lecture Theatre of the Science Museum, South Kensington, London, S.W. 7. Presentation of short papers. 5.30 p.m.

Societe des Ingenieurs Civils de France: British Section.—In the Lecture Hall of the Institution of Structural Engineers, 10, Upper Belgrave-street, S.W. 1. Presidential address by Major F. M. G. Du-Plat-Taylor, "The Industrial Situation in Great Britain; and World Progress in Docks and Harbours since 1918." 6 p.m.

THURSDAY, OCTOBER 15TH.

Institution of Mechanical Engineers.—Annual dinner. Postponed.

Institution of Municipal and County Engineers.—North-Eastern District meeting at Burnhope Reservoir, Wear-head. Meet at Cowshill Hotel, Wearhead. Luncheon, 12 noon.

Institution of Welding Engineers.—At the Institution of Mechanical Engineers, Storey's-gate, St. James's Park, S.W. 1. "Autogenous Welding of Lead and its Alloys, Ancient and Modern," by Mr. E. B. Partington. 7.45 p.m.

Manchester Association of Engineers.—At the invitation of the Institution of Mechanical Engineers, North-Western Branch, Engineers' Club, Albert-square, Manchester. "Racing Motor Car Design," by Mr. R. A. Railton. 7.15 p.m.

Manchester Geological and Mining Society.—At Queen's Chambers, 5, John Dalton-street, Manchester. Annual general meeting, 4 p.m. The Council will meet at 3 p.m.

Optical Society.—At the Imperial College of Science and Technology, Imperial Institute-road, South Kensington, S.W. 7. Meeting at 7.30 p.m.

FRIDAY, OCTOBER 16TH.

Institution of Mechanical Engineers.—Storey's-gate, Westminster. Special General Meeting. By-laws. 6 p.m.

Institution of Municipal and County Engineers: North-Western District.—Visit to works of G. and T. Earle, Ltd., at Hope, Derbyshire. Leave Manchester 11.15 a.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. Informal meeting. "The Characteristics of Commercially Pure Iron," by Mr. C. C. Berger. 7.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders.—In the Lecture Theatre, Literary and Philosophical Society, Newcastle-upon-Tyne. Annual general meeting. Presidential address by Mr. John McGovern. 6 p.m.

Overhead Lines Association.—At the Georgian Restaurant, Harrods, Ltd., Knightsbridge. Conversazione and Supper-dance. 8 p.m. to midnight.

University of London.—At the Institution of Electrical Engineers, Victoria Embankment, London, W.C. 2. Advanced Lecture in Engineering, "The Measurement of Light: Its Basis and its Significance," by Mr. E. C. Crittenden. 5.30 p.m.

West of Scotland Iron and Steel Institute.—Royal Technical College, George-street, Glasgow. Presidential address by Mr. John Bird. 7.15 p.m.

SATURDAY, OCTOBER 17TH.

Institution of Civil Engineers: Manchester and District Association.—Visit to Clarence Dock Power Station, Liverpool. Leave Manchester, Victoria Station, 1.35 p.m., meeting at Power Station, 2.30 p.m.

Institution of Municipal and County Engineers.—Southern District meeting at Newbury. Assemble in Council Chamber, Municipal Buildings, 11.15 a.m.

TUESDAY, OCTOBER 20TH.

Illuminating Engineering Society.—At the Lighting Service Bureau, 15, Savoy-street, Strand, W.C. 2. A Report on Progress in Illuminating Engineering, prepared by the Technical Committee, will be presented. 7 p.m.

Institute of Fuel.—At the Institution of Mechanical Engineers, Storey's-gate, Westminster, S.W. 1. Presidential address, Sir Hugo Hirst, Bart. Paper, "Selected Problems Relative to the Coal Industry," by Mr. B. Pochobradsky. 6 p.m.

Institute of Transport.—At the Institution of Electrical Engineers, Victoria Embankment, W.C. 2. Lecture for graduates and students, "Some Present Limitations in the Transport of Freight Traffic by Railway, with Suggestions," by Mr. H. W. Payne. 6 p.m.

WEDNESDAY, OCTOBER 21ST.

Institute of Fuel.—At the Connaught Rooms, Great Queen-street, London, W.C. 2. Annual dinner and dance. 6.45 for 7.15 p.m.

Institution of Production Engineers: Birmingham Section.—Grand Hotel, Birmingham. "Control of Factory Production," by Mr. T. G. Heckles. 7 p.m.

THURSDAY, OCTOBER 22ND.

Institute of Fuel.—At the Institution of Mechanical Engineers, Storey's-gate, Westminster, S.W. 1. "Marine Reciprocating Steam Plants: Some Outstanding Factors of Economy," by Mr. Alrik Björklund. 6 p.m.

Institute of Metals: Birmingham Local Section.—In the Chamber of Commerce, New-street, Birmingham. Address by Sir William Larke, K.B.E. 7 p.m.

Institution of Electrical Engineers.—Victoria Embankment, London, W.C. 2. Presidential address by Captain J. M. Donaldson. 6 p.m.

FRIDAY, OCTOBER 23RD.

Faraday House Old Students' Association.—At the Savoy Hotel, Strand, W.C. 2. Twenty-third annual dinner.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, S.W. 1. Presidential address by Lieut.-Colonel E. Kitson Clark. 6 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. Informal meeting. "Some Instruments Used in Connection with Power Plant," by Mr. I. Fagelston. 7.30 p.m.

MONDAY, OCTOBER 26TH.

Institution of Mechanical Engineers: Graduates' Section.—Storey's-gate, St. James's Park, S.W. 1. "The Manufacture of Wire," by Mr. W. W. S. Robertson. 6.45 p.m.

FRIDAY, OCTOBER 30TH.

Institution of Chemical Engineers.—In the Lecture Theatre of the Institution of Civil Engineers, Great George-street, S.W. 1. "Hydrogenation," by Dr. E. F. Armstrong, F.R.S. 6.30 p.m.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, S.W. 1. Informal meeting. Discussion on "Engineering in Agriculture," to be introduced by Mr. R. Borlase Matthews. 7 p.m.

Institution of Mechanical Engineers: East Midland Branch.—University College, University Park, Nottingham. Chairman's address, "The Importance of Metallurgy to the Engineer," by Professor C. H. Bulleid. 6.30 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. "Automatic Combustion Control," by Mr. S. J. Clifton. 7.30 p.m.

SATURDAY, OCTOBER 31ST.

Institute of Metals: Birmingham Local Section.—At the Queen's Hotel, Birmingham. Dinner and dance. 7 p.m.

Institution of Production Engineers.—Grand Hotel, Birmingham. Annual dinner. 7 p.m. for 7.30 p.m.

FRIDAY, NOVEMBER 6TH.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, S.W. 1. Thomas Hawksley Lecture, "The Mechanical Aspects of Electricity," by Mr. Llewellyn B. Atkinson. 6 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. "The Cooling of the Crude Oil Engine," by Mr. A. P. Quarrell. 7.30 p.m.